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Dental health in relation to age and dental care

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CONTENTS:

	Page
INTRODUCTION	3
MATERIAL	6
METHODS	8
RESULTS	24
AGE DISTRIBUTION, EDUCATIONAL LEVEL, "DENTAL CARE"	24
DENTAL HEALTH STATE 1971	30
Tooth loss	35
Restored teeth	40
Caries	48
Periodontal index	54
Periodontal bone height proximal to molars and premolars	59
CHANGES IN DENTAL HEALTH CONDITIONS BETWEEN 1965 AND 1971	67
Tooth loss	68
Restorations 1965-1971	76
Periodontal bone height 1965-1971	83
DISCUSSION	88
SUMMARY	106
ACKNOWLEDGEMENTS	112
REFERENCES	113

INTRODUCTION

Surveys from all over the world have shown that some form of dental disease, is present in almost all persons, and also that it´s severity varies widely. Great efforts have been made in many countries to grasp the size of this problem as a basis for measures to reduce the impact of dental disease.

Two questions which arise when investigating the dental health of a population are: What effect have dentists and dental treatment on dental health, and is the present approach of society towards prevention and treatment rational and effective?

Many previous investigations on dental conditions have been made on a longitudinal scale, such as The Vipeholm dental caries study (1954) and the works of Lövdal et al. (1958), Brandtzaeg (1964), Suomi et al. (1971a, 1971b). Such studies have considered only some parts of the dental health problems. In the present study an attempt was made to obtain a somewhat more comprehensive wiew of the dental health of a population and to study, to some degree, the impact of dentistry on the effects of periodontal disease and caries, the two main dental diseases. To this end some parameters of the dental health within groups of people with different frequencies of dental treatment, (different "dental care groups") were compared.

The basic weakness of this approach is that the distribution of natural resistance, and of causative and modifying factors, amongst the participants is not known. There are, however, some signs suggesting that the distribution of such factors is tolerably uniform, and my attempt may therefore be regarded as justified.

O W N I N V E S T I G A T I O N

Dental research has now established the principles and practical techniques for effective prevention and treatment of caries and

periodontitis. Therefore, modern dentistry ought to have an obvious effect on the actual occurrence of the main dental diseases.

The dentist/population ratio in Sweden is one of the highest in the world (at the end of 1972 one to 1100 inhabitants). In Malmö, where the study reported here has been performed, the rate is one dentist to 7-800 inhabitants. Dental treatment is consequently readily available,and the possibilities of evaluating the effects of today´s dentistry on dental health ought to be rather favourable.

Since most dental disease results in irreversible tissue defects, a cross-sectional study largely presents a summary of past dental experience. Consequently, a single examination cannot give a clear picture of the actual progression of dental disease. This survey was therefore partly made longitudinal so that the progression and treatment of caries and periodontal disease during a six year period could be studied.

Several surveys have demonstrated that the dental status of an individual is related to socio-economic factors. For literature on the epidemiology of dental caries and periodontal disease reference is made to the following reviews: Löe (1963), Waerhaug (1966), Glickman (1972), v. der Fehr and Möller (1973) and Russell (1973). However, a result of the changes that have taken place in Sweden during the last half century, the social and economic variations between people are moderate compared with those in most other Western countries. The individuals studied in this survey were all staff in the same factory, and can be regarded as a rather homogeneous sociological group. Consequently, an evaluation of the influence of dental treatment on their dental status can be made to some degree without taking socioeconomic factors into consideration.

AIM

The aim of this investigation has been to throw light on the relationships between dental health, age and dental care (frequency of visits to a dentist), and to find out whether the progression of dental disease during a six year period is influenced by age and/or dental care.

MATERIAL

In 1964-66 H Björn conducted a dental health investigation on employees of the Kockums Mekaniska Verkstads AB in Malmö, Sweden, one of the big shipbuilding yards in Europe (Björn and Holmberg 1966, 1967, Björn 1971). This investigation covered all male staff members and a subsample of manual workers and has served as a basis for the present study. In 1971 both the staff and the manual workers still being employed by the same company were invited to take part in a second dental health examination. The findings in the manual workers will be reported separately.

The staff were examined in 1965, and the original group numbered 1431 persons. The dental state was assessed in 1219 of these or 85.2 per cent. During the interval 1965 to 1971, 197 of the staff members had retired and only 9 of the 48 individuals in the two youngest age groups were still employed by Kockums. These age groups are therefore not considered in this report. Of the remaining 947 persons, 706 or 73 per cent were still employees of the same company. 53 persons did not take part due to various reasons. 34 staff members were not available due to illness, vacation or work abroad. An analysis of the causes of non-participation is given in Table 1.

Table 1. Distribution of non-participants on age and education.

Age gr.	3			4			5			6			7			8			9			All age groups			
Educ.gr.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Total
Refusal	1							2		2				4	1	1	4	1	2	1		5	12	2	19
Illness	1						1	1	2	1	4	1	2	4		4	1	1	3	1		11	12	4	27
Vacation				2							1	1		1					1	1		3	3	1	7
Total	2			2			1	3	2	3	5	2	2	9	1	5	6	2	5	3		18	28	7	53

There is no reason to believe that non-availability had anything to do with the dental health state. Consequently, the 34 non-available persons were deducted from the material. Of the remaining 672 individuals, 97.2 per cent were examined, while 19 or 2.8 per cent did not wish to take part. Among the non-participants, 8 were edentulous at the examination in 1965 and 6 were edentulous in either the upper or lower jaw.

Of the 653 persons, which were examined in 1971, 9 did not participate in the interview which was a part of the examination. (Six of these individuals were edentulous and one was edentulous in the upper jaw.) This means that 644 persons were interviewed.

METHODS

COLLECTION OF THE MATERIAL

Data on age and education were obtained from the Kockum´s personnel administration office, making it possible to identify all staff members employed in 1965 as well as in 1971.

The examination in 1965 (I) was made at the Dental School in Malmö. In 1971 (II) the participants were examined on the premises of the company, where some rooms were fitted with the necessary dental equipment. Furthermore, the participants were summoned via the personnel administration office, which may explain the rather high participation rate.

The interval between the two examinations was on an average 6 years and 1 month, with a range between 5 years 10 months and 6 years 5 months.

EXAMINATION

Each participant was subjected to a series of examinations in the following order: orthopantomography, intra-oral bite-wing roentgenography, colour photography, a clinical examination and an interview on dental history and attitudes.

ORTHOPANTOMOGRAPHY

Panoramic roentgen examination with a Paatero orthopantomograph (Paatero 1960) was made at each of the examinations.

Each pair of roentgenograms from 1965 and 1971 was analysed as follows. The roentgenogram from 1965 was first evaluated and scored. Later but at the same occasion the film from 1971 was scrutinized and scored. This parallelism in the evaluation of roentgen findings was employed, among other things, to obtain a more reliable identification of the remaining teeth, necessary for the comparative studies of the two examination series.

ASSESSMENT OF THE PERIODONTAL BONE HEIGHT

An assessment of alveolar bone loss by clinical measurements of the distance between the cemento-enamel junction and the epithelial attachment (e.g. Ramfjord 1959) is time-consuming. Since the time for the entire examination of each participant was limited in the present study, it was decided to employ a roentgenographic method applicable to orthopantomograms. It has been shown by Ainamo et al. (1968) that orthopantomography gives a more accurate record of the true interdental bone height, than does intra-oral full mouth roentgenography.

The proximal periodontal bone heights were assessed by a method basically similar to that described by Björn and Holmberg (1966) which was shown to be suitable for measurements on orthopantomograms. This in its turn, was developed from a series of techniques described by earlier workers (Miller et al. 1940, Marshall-Day et al. 1949, Mühlemann 1955, Schei et al. 1959, Engelberger et al. 1963).

Instead of the 5 degree scale employed by Björn et al., one similar to that of Schei et al. with 10 equidistant divisions was used, Fig. 1.

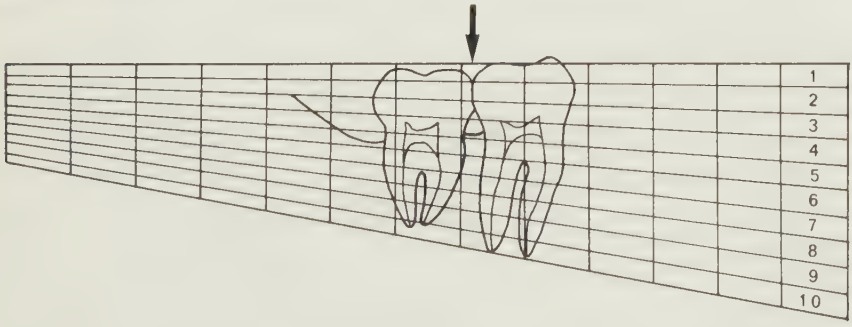


Fig. 1. Ruler used for measuring bone heights. Scale fitted to image of distal surface of right mandibular second molar. The bone score in this specific case is 4.

This scale makes a more accurate assessment than that of Björn et al. possible, which was considered essential to be able to evaluate any differences between the results of the two examinations.

In cases with numerous remaining teeth even the roentgenographic evaluation of bone heights would have been very time-consuming. For this reason the bone heights were assessed by use of an abbreviated index described by Björn et al. (1974) which confines measurements to the mandibular molar and premolar regions. The figures obtained were shown to be closely correlated to those for the 32-teeth dentition, Table 2. Also in small groups e.g. separate age groups comprising 5 to 10 individuals there was a high degree of correlation.

This index can be used to advantage whether scales with 5, 10 or 20 divisions are employed, Table 3. The mandibular molar and premolar areas were chosen because of the ease and speed with which measurements could be made in this region due to the favourable anatomy and, consequently, favourable projektion and low non-measurability figures.

In a methodological study on another sample Björn and Holmberg (1966) have shown that about 20 per cent of the bone heights were non-measurable, about 25 per cent in the maxilla and 15 per cent in the mandibula. It is noteworthy that mandibular molar areas showed the lowest degree of non-measurability, 2.6 per cent, while the corresponding figure for mandibular premolar areas was 18.1 per cent.

Non-measurability percentages obtained in the present investigation are given in Table 4. The orthopantomograms obtained in 1971 were of higher quality than those from the 1965 investigation, which is evident from the difference in the non-measurability figures.

Table 2. Correlation between periodontal proximal bone heights scored from the mandibular molar and premolar areas on one hand and other areas of the 32-teeth dentition or the total 32 teeth dentition on the other. (Staff members, 1965). Figures denote coefficients of linear correlation. Sample sizes within parentheses.

Mandibular molar and premolar areas	Complementary areas			32-teeth dentition		
	Mes	Dist	Mes+dist	Mes	Dist	Mes+Dist
Mesial	.72	.68	.72	.88	.81	.86
	(1031)	(1040)	(1044)	(1053)	(1051)	(1053)
Distal	.67	.65	.68	.79	.87	.84
	(1035)	(1044)	(1048)	(1055)	(1055)	(1055)
Mesial +	.72	.69	.73	.86	.88	.89
+ Distal	(1036)	(1045)	(1049)	(1058)	(1056)	(1058)

Table 3. Correlation between bone scores obtained from the 1965 sample with a five and a ten degree scale. Figures denote coefficients of linear correlation. Sample size within parentheses.

	5-degree scale								
10 - degree	Molar + Prem. areas			Molar areas			Premolar areas		
scale	Mes	Dist	Mes+Dist	Mes	Dist	Mes+Dist	Mes	Dist	Mes+Dist
Mesial	.84	.77	.84	.85	.71	.83	.80	.74	.81
	(612)	(612)	(612)	(551)	(530)	(551)	(528)	(529)	(530)
Distal	.76	.88	.87	.73	.87	.86	.68	.85	.82
	(620)	(623)	(623)	(555)	(556)	(557)	(568)	(590)	(591)
Mesial +	.83	.87	.89	.85	.85	.91	.75	.84	.84
+ Distal	(620)	(623)	(623)	(557)	(558)	(559)	(571)	(593)	(594)

Table 4. Non-measurability percentages obtained at evaluation of the 1965 and 1971 orthopantomograms.

	1965	1971
Molars	10.0	7.9
Premolars	36.0	22.9
Total	23.6	15.8

INTRA-ORAL BITE-WING ROENTGENOGRAPHY

Each participant was subjected to intra-oral bite-wing roentgenography of the molar and premolar regions. This served as a basis for the assessment of proximal caries, defective margins of restorations and calculus.

CARIES

The following code was used when recording caries.

1 = lesions confined to the enamel

2 = caries penetrating into the dentine

3 = caries with evident or suspected pulp involvement

The same code was used for both primary and secondary caries. Caries of the root was recorded without notation of its extent.

DEFECTIVE MARGINS OF RESTORATIONS

Overhangs or deficiencies of radiopaque fillings or crowns were measured using a 7 x magnifying glass and a scale with 0.1 mm divisions (A-L Björn et al. 1969, 1970).
The size of such defects was noted, as follows.

1 = $>0.1 < 0.2$ mm (small)

2 = $\geq 0.2 < 0.4$ mm (medium)

3 = ≥ 0.4 mm (large)

The figures given probably do not overestimate the size of overhangs. They may instead give a somewhat too favourable impression. "The size of small overhangs is not influenced to any noteworthy degree by magnification and distortion within the limits for the clinically acceptable variations in horisontal projection." (Björn et al. 1973). "No overestimation of the size of the overhangs (due to variations in the vertical angulation) was made. On the contrary there seemed to be a risk of underestimation." (Håkansson et al. 1973).

CALCULUS

The occurrence of calculus on the proximal surfaces of molars and premolars was recorded from the bite-wing films using the same magnifier as above. Only the type of calculus, which in the roentgen image appears as a more or less triangular projection over the main tooth surface (in most cases serumal calculus), was noted.

COLOUR PHOTOGRAPHS

Colour photographs were taken in 1965 and in 1971. At examination I one photograph was obtained from each participant, while at examination II separate close-up photographs were also made of the maxillary and mandibular anterior regions.

The colour slides were a valuable complement to the roentgenograms when estimating the situation and type of fillings and crowns in the anterior regions.

CLINICAL EXAMINATION

The clinical examination in the 1971 investigation included scoring the P I according to Russell (1956, 1960), a calculus index, and recording the presence of crowns, bridges and removable prosthetic appliances.

P I = 6 was recorded when a pocket depth of more than 4 millimeters was assessed with the aid of a measuring probe.

Supragingival calculus was assessed at the lingual surfaces of the mandibular incisors using the following code:

Score	
0	No calculus.
1	Calculus covering $\leq 1/4$ of the height of the clinical crown.
2	Calculus covering $>1/4$ of the height of the clinical crown.

I N T E R V I E W

Each participant in the examination in 1971 was subjected to an oral interview. In order to obtain as reliable answers as possible, the interview took the form of a confidential discussion in a room wholly separated from the rest of the examination rooms.

The interview was carried out after the roentgenographic and clinical examinations. The interviewer never took part in these examinations and had no knowledge of their results.

The interview comprised a general part in which an attempt was made to assess the dental background of the examinee by data on the dental care before 1965, e.g. participation in school dental care, the year of the first visit to a dentist´s, the frequency of visits to a dentist´s. A special part covered data for the interval 1965 to 1971 including the year of the last visit to a dentist´s, the number of visits during the period, the name of the dentist or dentists, the reason why a dentist was seen, and the nature of examinations or treatment, if any.

Each participant was further questioned on symptoms of periodontal inflammation such as gingival bleeding and retraction, mobility of teeth and also on the reasons for any extractions.

Further the participants were asked if they had had any information on the causes of caries and periodontal disease and if so from what source: radio-TV, newspapers, weeklies, dentists or other sources.

This report will consider only the part of the interviews which deals with the frequency of visits to a dentist´s and the periodontal symptoms.

REPRODUCIBILITY OF THE READINGS

The recording was carried out by the author throughout the whole investigation. I order to find out whether the criteria used had been clearcut enough, a new recording was made one year after the first one for comparison with the original. For this part of the investigation the roentgen films and colour photographs from every 20th participant in the 1971 examination (34 individuals) were used.

The results are shown in Tables 5 a-c. The comparison of mean values was made with Student´s t-test for paired variables while for the comparison of proportions chi-square tests were used. These latter tests were not made in cases were the numerical values did not suggest any possibility of a significant difference. The calculations were made on figures for the whole test group as an entity. No significant differences were found. In fact, there was a rather close agreement between the two readings in each instant. In other words, the criteria used were found to be satisfactory.

DATA PROCESSING

All examination results were coded and recorded on forms, one form per participant, for each of the examinations I and II (Fig. 2, Table 6). The data were then transferred to punch cards, one card for each of the 32 possible teeth in each of the 653 in-

Table 5 a. Consistency of two readings at an interval of one year /1972 (I) and 1973 (II)/

Variable	Reading	N	Mean ± s.d.
Remade	I	30[1)]	5.40±.895[2)]
Restorations	II	26	4.81±.821
Overhangs	I	96[3)]	2.02±.091[4)]
mes	II	98	2.02±.089
dist	I	124[3)]	2.00±.078[4)]
	II	130	1.98±.077
Sec caries	I	21[3)]	1.62±.161[4)]
mes	II	21	1.67±.126
dist	I	26[3)]	1.58±.149[4)]
	II	33	1.67±.120
Bone scores	I	178[5)]	4.43±.057
mes	II	190	4.51±.052
dist	I	191[5)]	4.70±.060
	II	212	4.80±.056
mes+dist	I	369[5)]	4.57±.042
	II	402	4.66±.039

1) Number of individuals 2) Mean number of restorations made between 1965 and 1971 3) Number of restorations or carious lesions 4) Mean size of overhang or carious lesion 5) Number of measurable bone heights.

Table 5 b. Consistency of two readings at an interval of one year /1972 (I) and 1973 (II)/

Variable	Reading	N
Intact teeth	I	219
	II	222
Restored teeth	I	519
	II	517
Restored + restored and carious teeth	I	586
	II	587
Mes+dist amalgam restorations	I	437[3)]
	II	438
Mes+dist radiolucent restorations	I	99[3)]
	II	96
Buccal amalgam restorations	I	101[3)]
	II	104
Buccal radiolucent restorations	I	17[3)]
	II	15
Lingual amalgam restorations	I	19[3)]
	II	21
Bridge abutments	I	56
	II	53
Posts	I	51
	II	56
Endodontic treatment (Number of teeth)	I	152
	II	150
Proximal calculus	I	184
	II	189

Table 5 c. Variables that displayed no difference between the two readings.

	N		N
Remade crowns	13	Mesial amalgam restorations	197
Missing teeth	266	Occlusal amalgam restorations	301
Radices relictae	3	Gold restorations	15
Impacted teeth	1	Crowns	117

dividuals. These cards contained a various amount of data coded from 0 to 9 in the 74 columns used. For each of the participants two special cards were also used containing information concerning the individual as a whole (identification data, age, education, income, prosthetic appliances, anamnestic data etc., columns 1-37).

The punch-card processing was followed up by a careful search for incomplete or contradictory entries. This search was rather time-consuming but was carried out in great detail.

The information on the punch-cards was then transferred to magnetic tape for further treatment by a Univac 1108 computer at the Lund University Computing Center.

STATISTICAL METHODS

Standard statistical methods were used as described by Snedecor and Cochran 1967 (S&C), Sokal and Rohlf 1969 (S&R) and Siegel 1956 (S).

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
1. saknas 2. rad. rel. 3. retinerad 4. intakt 5. fylld 6. kariös 7. kron. sakn. 8. påg. beh. 9. kariös + fylld ALLMÄNT TAND				FYLL-NING				KRONA							ENDO-DONT. BEH.					KARIES				BONE			KLIN. UND.				FÄRG-FOTO					
				mesialt	distalt	ocklusalt	buccalt	metall	radiolucent	ålder	BRO	STIFT	RANDAN-SLUTNING m	RANDAN-SLUTNING d	när	när ej	utanför	ampu.t.	PERIODONTALK.	mesialt	distalt	ocklusalt	buccalt	mesialt	distalt	SUBGING. TST	PI	mobilitet	borstskad.	mes. diast.	retrakt.	volym	färg	missf. pell.	plaque	salivsten	kronsk. läge
	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
8+	0	1																																		
7+	0	2																																		
6+	0	3																																		
5+	0	4																																		
4+	0	5																																		
3+	0	6																																		
2+	0	7																																		
1+	0	8																																		
			40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
+1	0	9																																		
+2	1	0																																		
+3	1	1																																		

Fig. 2. Form for recording examination results and personal characteristics (cf. Table 6).

Table 6. Codes for recording examination results (cf. Fig. 2)

Code nr	
1	1 = staff member; 2 = worker
2-5	identification number
6	year of examination
7	sex
8-9	age group
10	educational level
11	income
12	prostethic appliances
13	age of prostethic appliances
14	denture made by .....
15-16	remade restorations (0-99 surfaces)
17	remade crowns (0-9 teeth)
18	1. colour photographs missing 2. " " not recordable 3. not participating in 1965 4. interview missing
19	number of dentists visited during 1965-1971
20-23	dental treatment during school
24	duration of regular or irregular treatment frequency resp.
25	year of last treatment to a dentist´s
26	initiator for visiting a dentist´s
27	frequency of " "
28-29	periodontal treatment
30	roentgenographic examination during 1965-1971
31-33	periodontal symptoms
34-35	information on causes of caries and periodontitis .
36	information to the dentist or the participant about the result of this investigation
37	last time for scaling
38-39	tooth number
40	1. missing 6. carious 2. radix relicta 7. crown missing 3. impacted 8. under treatment 4. intact 9. restored + carious 5. restored
41-44	fillings; type and position
45-46	crowns (type)
47	age of crowns
48	bridges
49	posts and pins; type and number
50-51	marginal restoration defects; size and position
52-55	endodontic treatment; type and position
56	periapical changes
57-60	caries; type and position
61-62	bone score; mesial and distal
63	proximal calculus on posterior teeth
64	periodontal index

65 tooth mobility
66 defects from tooth brushing
67 mesial diastema
68 gingival retraction
69-73 registrations from the reading of the colour photographs about gingival health and plaque
74 position of artificial crown margins in relation to gingival margin.

COMPARISON BETWEEN THE ORIGINAL AND THE RE-EXAMINED GROUPS

In order to find out whether the dental state within the re-examined group differed appreciably from the original group examined in 1965, a comparison was made of the dental state of dentulous individuals in both groups (944 persons from the original and 626 from the re-examined group). The following parameters were compared: viz.numbers of missing, intact and restored teeth. For this investigation the data from the 1965 examination of orthopantomograms were used (Björn 1971). In this study no regard was paid to dental care frequency, and the subjects were divided according to educational level.

Rather small and in no instance statistically significant differences (chi-square tests) were encountered. Fig. 3 illustrates conditions within the total samples but holds true also for the separate educational groups. This may be taken as an indication that the dental state of the two groups was not greatly different as far as missing, intact and filled teeth were concerned. It may be inferred that the dropping out of cases was not correlated to the dental state.

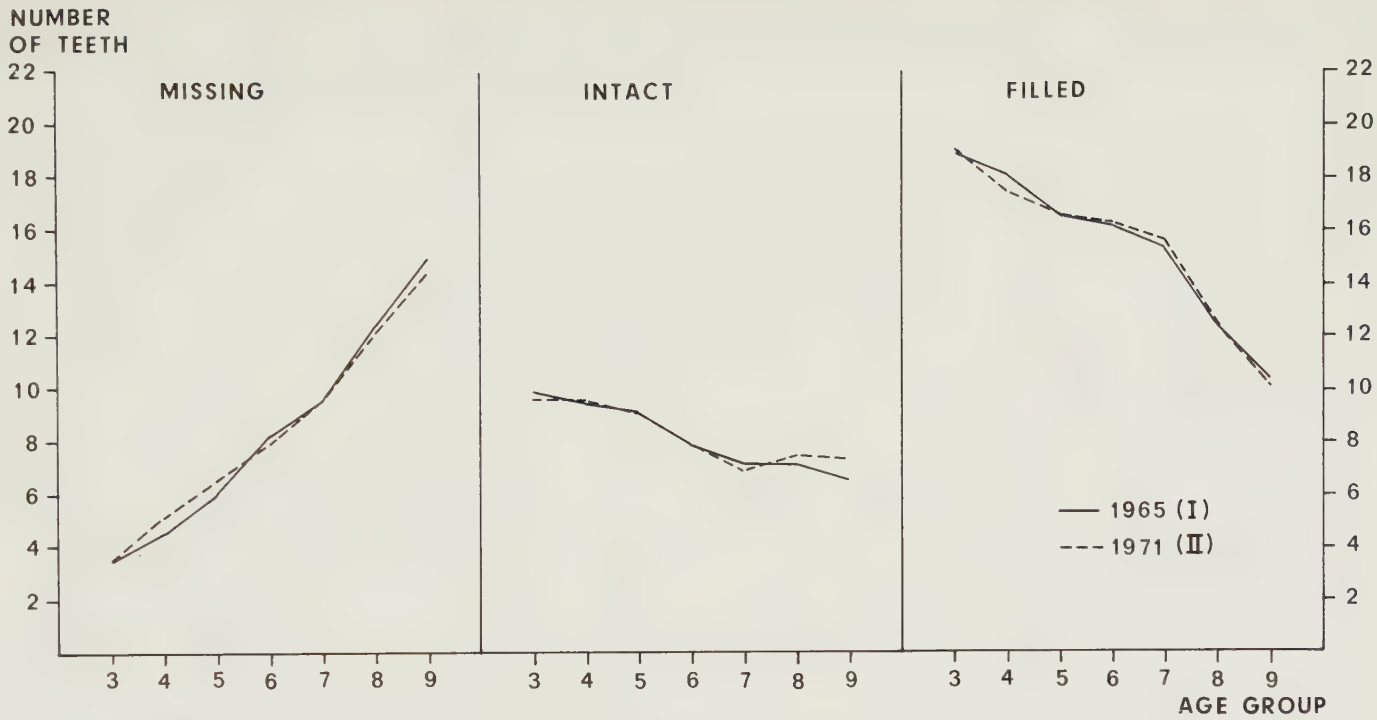


Fig. 3. Comparison between the original and the re-examined groups

AGE DISTRIBUTION

The subjects were divided into groups covering five birth years each, and these groups were given numbers from 3 to 9, corresponding to the notations used by Björn (1971) in his report on the original group of Kockum´s employees.

The actual age span within each group at the time of the two examinations, and the distribution of participants by age are given in Table 7.

EDUCATIONAL LEVEL

The educational level was divided into three grades. Grade 1 = = "low" was used for persons with an educational level below low certificate examination; grade 2 = "medium" denoted persons with a lower certificate examination while grade 3 = "high" comprised persons with a higher certificate examination.

Of the 653 examined persons, 196 or 30.0 per cent belonged to the group "low", 285 or 43.6 per cent to the group "medium" and 172 or 26.3 per cent to "high" educational level group. Figures for the total group examined in 1965 were 269 or 27.6 per cent, 431 or 44.3 per cent and 273 or 28.1 per cent respectively. The distribution of the educational groups on age is evident from Table 7 and Fig. 4.

"DENTAL CARE"

The frequency of treatment periods, here denoted as "dental care", was divided into four groups. A, B, C and D:

A = one treatment period per year } = yearly d.c. group
B = two or more treatment periods per year }
C = regular but not yearly visits
D = sporadic visits = sporadic d.c.group

Table 7. Distribution of the participants on age, educational level and dental care groups.

Age group		3	4	5	6	7	8	9	Total
Actual age	1965	25-29	30-34	35-39	40-44	45-49	50-54	55-59	
	1971	30-35	36-40	41-45	46-50	51-55	56-60	61-65	
	n	41	69	96	141	142	112	52	653
Educational level	1	8	21	25	28	41	44	29	
	2	16	26	36	78	63	50	16	
	3	17	22	35	35	38	18	7	
Interviewed group	n	41	69	94	141	141	109	49	644
Dental care group	A	23	28	32	58	56	33	11	
	B	12	22	29	37	33	26	10	
	C	2	9	14	19	21	10	7	
	D	4	10	19	27	31	40	21	

Educ. gr		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Dent.care gr.	A	2	8	13	8	10	10	6	13	13	8	34	16	18	24	14	9	13	11	5	5	1
	B	6	5	1	6	10	6	6	12	11	8	18	11	4	18	11	13	11	2	7	1	2
	C		1	1	2	3	4	5	1	8	3	9	7	5	5	11	3	3	4	3	3	1
	D		2	2	5	3	2	8	8	3	9	17	1	13	16	2	18	21	1	12	6	3

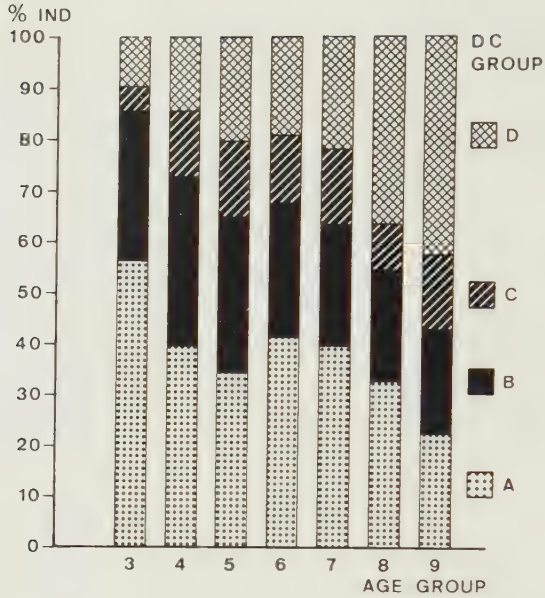


Fig. 4. Distribution of participants on age and educational level.

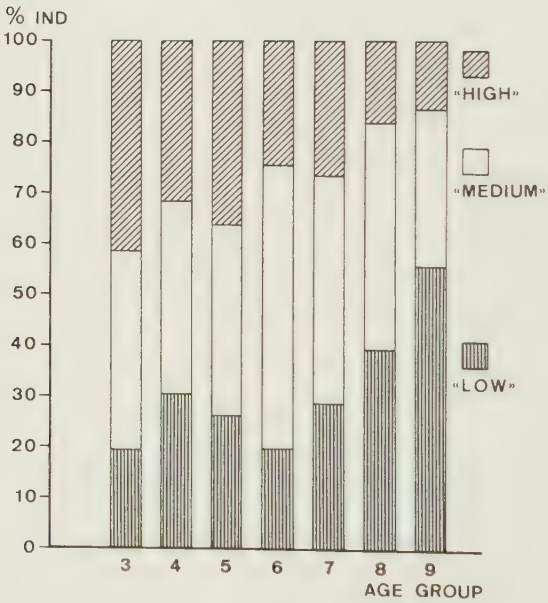


Fig. 5. Distribution of participants on age and dental care.

The duration of the actual treatment frequency must be presumed to have a bearing upon the dental health state. The interval between the two examinations 1965 and 1971 or six years was considered as the limit for deciding whether a participant belonged to a certain dental care group. For those who had changed their dental care habits within a shorter period of time, the average frequency during the six years was calculated. They were then placed in the group closest to this average.

Nearly 64 per cent of the participants in the 1971 examination had had dental treatment at least once a year (groups A+B) with a decreasing proportion with increasing age.

The distribution of "dental care" within age and educational groups is shown in Table 7 and Figs. 5 and 6. As has recently been shown by Bulman et al. (1968) and Smedby (1965, 1972) the frequency of dental care is related to age and sociological factors among other things. The present study confirms that the frequency of dental treatment decreases with increasing age and that individuals with "high" education are underrepresented in the sporadic dental care group.

Participation in a dental health investigation may influence the participants to increase their treatment frequency. The interviews showed that 29 individuals (7 %) of those with yearly dental treatment started with this frequency after the first examination in 1965.

RELIABILITY OF THE DATA ON DENTAL CARE FREQUENCY

In order to test the reliability of the anamnestic data on dental care frequency a sample of 55 participants taking part in the interviews was drawn by aid of a random number table. 30 of these persons belonged to group A, with one, and 25 to group B, with two or more treatments per year.

The dentist of each person in this subsample was contacted and

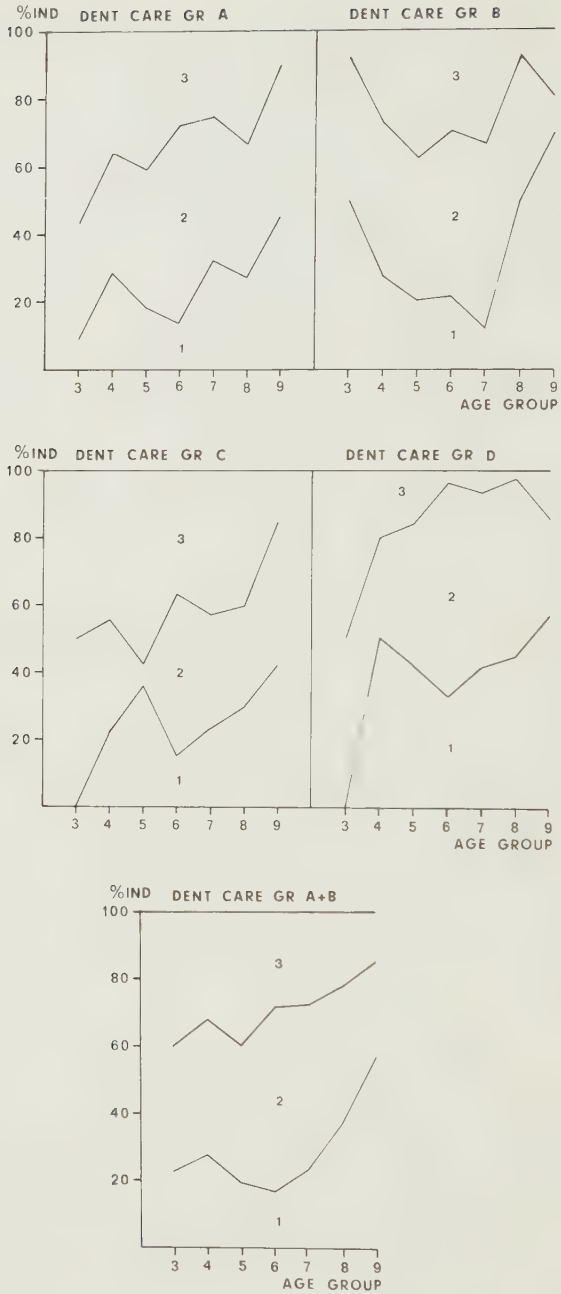


Fig. 6. Distribution of participants on age, dental care and educational level.

asked to state, after consulting his records, the frequency of treatment periods during the years 1965 to 1971. The dentist referred to by one of the participants could not be contacted, and one dentist stated that the patient was not in his files. Information was obtained concerning the other 53 participants.

The degree of consistency between anamnestic and dentist´s data is evident from Table 8. Only minor discrepancies were encountered. Four of the participants stating that they had had treatment once a year had some years had two treatment periods, and five of those stating that they had had two treatment periods each year had not every year had dental visits twice. These were borderline cases between dental care groups A and B. It is important to note that when dental care groups A and B are combined, there was only one individual who according to the dentist´s record, rightly should not belong to this category but to dental care group C. In no cases participants, who claimed to have had yearly dental care, were recorded by the dentist as belonging to the group with only sporadic dental treatment.

The conclusion can be drawn that the participants were capable of stating the frequency of dental visits with great accuracy.

Table 8. Degree of consistensy between participant´s and dentist´s data on dental care.

Sample	A	B
Dentist not contactable	1	
Subject not in files	1	
Consistent statements	22	19
Less frequent treatment according to dentist	2	5
More " " " " "	4	1
Total	30	25

52 or 8 % of the participants stated that they had had no treatment during the last six years. The distribution of the remaining 592 individuals amongst the dentists was:

Private practitioners	497 (84 %)
Dental School	49 (8 %)
Public dental service	46 (8 %)

Of those participants who had visited private practitioners 468 named 183 different dentists while 29 did not name their dentist.

D E N T A L H E A L T H S T A T E I N 1 9 7 1

EDENTULOUS SUBJECTS

The term edentulous is here used in a clinical sense, and thus, impacted teeth are disregarded, as are radices relictae, i.e. remnants of teeth which cannot be restored.

Sixteen individuals (2.5 %) were edentulous at the 1965 examination, while at the 1971 examination 27 individuals (4.1 %) were edentulous. Six of the 27 edentulous individuals refused to take part in the interviews. Those six cannot be classified according to dental care. Four were persons which had become edentulous during the interval 1965-1971 while two were already edentulous at the first examination.

It may be of some interest that of those who took part in the interview 1971, 19 individuals or 12.5 per cent of the group that had had only sporadic dental treatment were edentulous. Only two persons or 0.8 % of the group with yearly dental treatment had lost all their teeth. The difference is statistically significant at the 0.1 per cent level.

DENTATE INDIVIDUALS

The report that follows deals with the dental state in dentate individuals in relation to age and dental care. The distribution of this group is delineated in Table 9.

Table 9. Distribution of dentate individuals on age and dental care

Age gr.	3				4				5				6			
Dental care gr.	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
N	23	12	(2)	(4)	28	22	9	9	32	29	14	19	57	37	19	25
Total number	41				68				94				138			

Age gr.	7				8				9			
Dental care gr.	A	B	C	D	A	B	C	D	A	B	C	D
N	55	33	21	24	33	26	10	34	11	10	7	18
Total number	133				103				46			

DMF - teeth

A common way to illustrate the deterioration of teeth is to state the percentages of decayed, missing and filled teeth, DMF according to Klein and Palmer (1938). The DMF - index, which originally was employed for the description of dental deterioration in children, may give a rough idea of the dental state also in adults. It provides "a conveniant summary of the lifetime toll of dental disease in the permanent dentition" {Johnson et al. (1965)}.

In the present investigation the 32-teeth dentition was the basis for most calculations, since only adults have been examined and since it was often impossible to differentiate with certainty between second and third molars in jaws where one or two molars were missing. Missing teeth are always related to the 32-teeth dentition while percentages of filled and carious teeth will also be given in relation to the number of remaining teeth.

The DMF-percentages are reported in Fig. 7 from which it is evident that in this sample there were rather small variations with age and dental care. In spite of this, considerable differences in dental health state may be present as is clear from Fig. 8 where DMF is replaced with impacted, intact, carious, restored, restored and carious as well as missing teeth. The distribution here was also calculated on the 32-teeth dentition.

The proportion of intact teeth does not vary to a very large extent with either age or dental care. The greatest differences seem to occur in the proportions of missing and filled teeth.

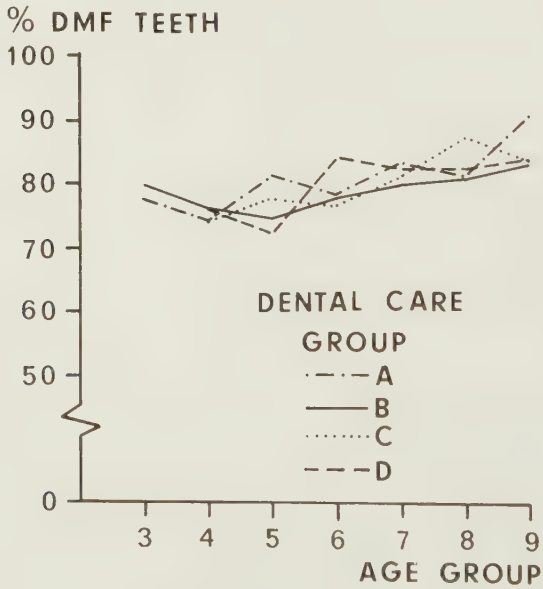


Fig. 7 Distribution of DMF-teeth on age and dental care.

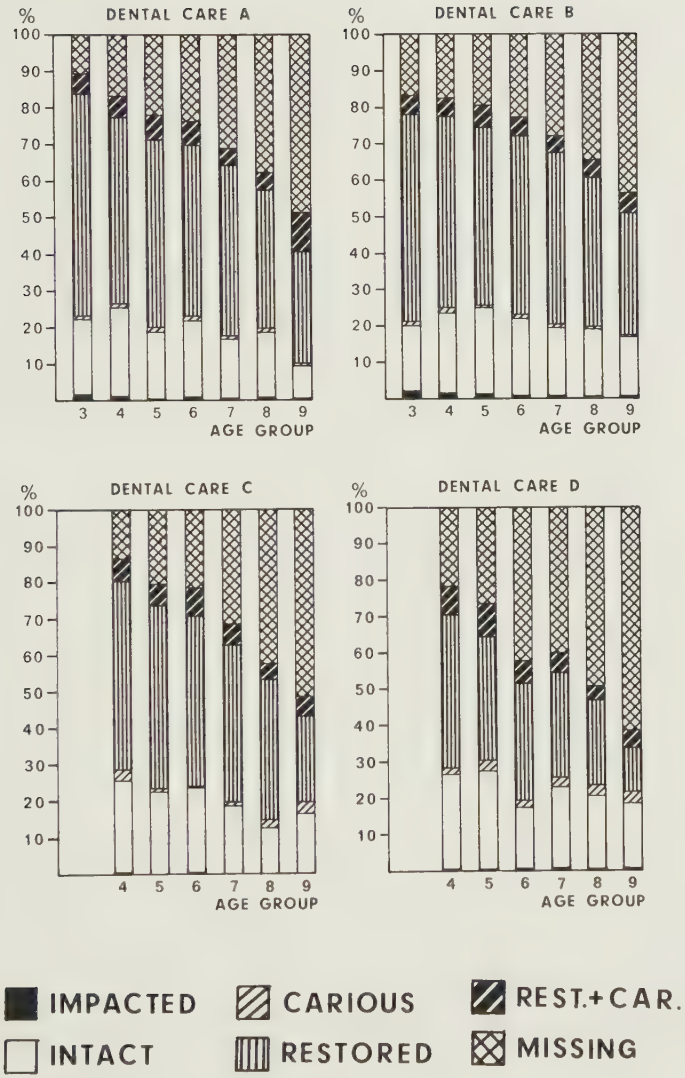


Fig. 8. Distribution of impacted, intact, carious, restored, restored and carious, as well as missing teeth on age and dental care.

Missing, intact, carious and restored teeth in relation to dental care.

The influence of dental care on the dental health state was tested as follows:

The dental care groups A and B were first tested as described below. Since no appreciable differences were found, these two groups were combined and designed as the group "yearly dental care". This group was then compared with the group with only sporadic dental care (group D).

To test the significance of differences in frequency distribution of missing, intact, carious and restored teeth (in the 32-teeth dentition) the extension of the median test was used (Siegel 1956). In this way significance levels were obtained for each age. The results are exemplified for restored teeth in Table 10.

Table 10. Distribution of restored teeth on age and dental care. Extension of the median test (- = scores smaller than the common median).

Age group	Dental care group						Level of significance
	Yearly			Sporadic			
	-	+	%	-	+	%	
4	21	29	42.0	4	5	44.4	N.S.
5	23	38	37.7	13	6	68.4	$p < 0.05$
6	41	53	43.6	16	9	64.0	N.S.
7	35	53	39.8	18	6	75.0	$p < 0.005$
8	18	41	30.5	23	11	67.6	$p < 0.005$
9	5	16	23.8	12	6	66.7	$p < 0.025$

Significant differences were found between the yearly and sporadic dental care groups in the distribution of missing and restored teeth, while there were no significant differences in the distribution of intact and carious teeth. Regression and covariance analyses were also made, see under the heading "Tooth loss".

Tooth loss

The number of remaining teeth is reduced with rising age, as has been shown by all the epidemiological studies dealing with this question. The reduction in the present sample may be illustrated by the percentages of tooth loss, in the youngest age group (30--35 years) about 12 per cent and in the oldest group (60-65 years) about 53 per cent.

The individual variations in the number of lost teeth were considerable and increased with increasing age. The quotient standard deviation/coded age, on the contrary, was fairly constant (Table 11). Bartlett´s test (S & C)showed that there was no significant inhomogeneity of variances in the sample when standard deviation/age was used instead of standard deviation. For the regression and covariance analyses formulae taking this relation into account were used (Fig. 9, Table 12).

Table 11. Missing teeth. Bartlett´s test on homogeneity of variances. Example from dental care group B.

Age gr.	3	4	5	6	7	8	9	
Number of individ.	12	22	29	37	33	26	10	p
Mean number	5.3	5.5	6.2	7.3	8.9	10.9	13.9	
Variance	4.75	11.76	15.05	28.73	27.04	43.16	42.77	< 0.001
$(s/X)^2$	0.53	0.74	0.60	0.80	0.55	0.67	0.53	> 0.10

The analyses showed no differences between the regression lines for dental care groups A and C, slight differences between those for dental care groups A and B, and considerable differences between those for dental care groups A and D. Thus, tooth loss was correlated to the dental care group. At ages 60 to 65 years those participants receiving yearly dental treatment had on an average lost 12 teeth per individual while the corresponding

figure for the group having only sporadic dental care was 20 teeth per individual.

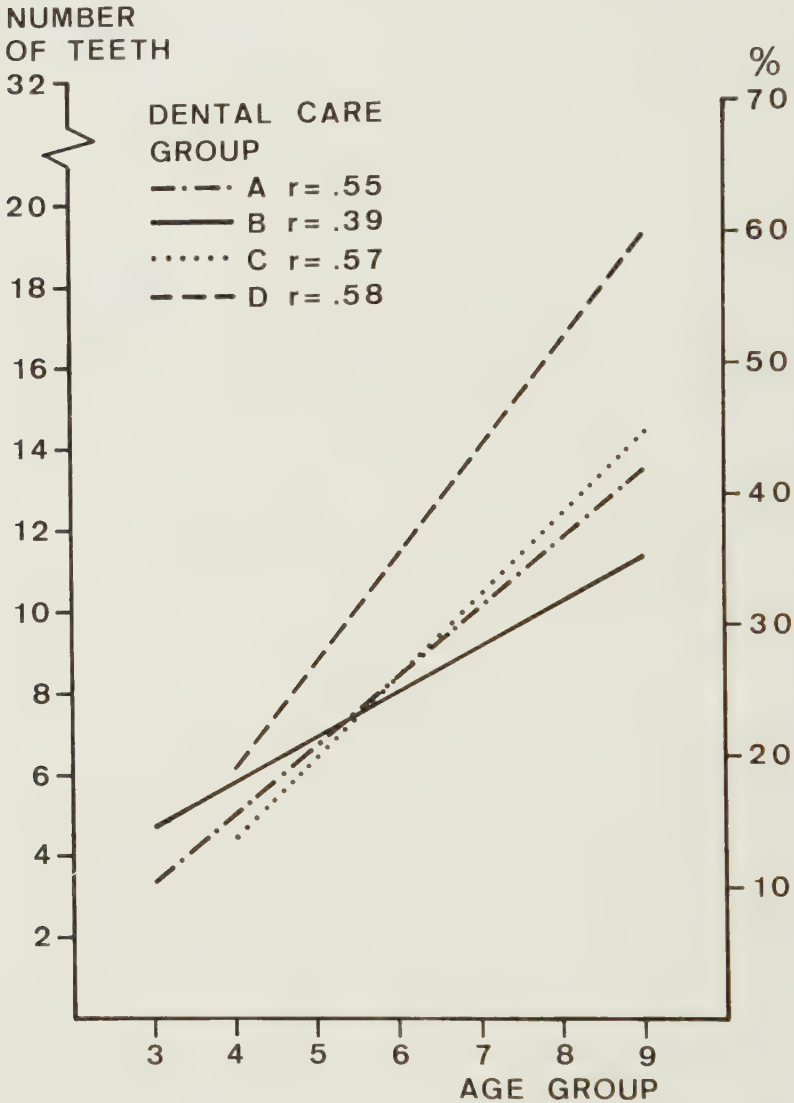


Fig. 9. Missing teeth. Mean number per individual in relation to age and dental care. r = coefficient of linear correlation.

Table 12. Missing teeth. Regression and covariance analysis (Cf. Fig. 9).

N = number of individuals, mean = mean number of missing teeth,
s.d. = standard deviation, a = y-intercept, b = regression coefficient,
s_b = standard deviation of b.

		N	mean	s.d.	a	b	s_b
Dental care gr.	A	239	8.4	.97	-1.64	1.67	.16
	B	169	8.0	.88	1.34	1.11	.20
	C	82	8.9	.94	-3.55	1.98	.32
	D	132	13.2	1.32	-4.39	2.62	.32

Comparison of regression lines.
d.f. = degrees of freedom, p = probability.

	F-slopes	d.f.	p	F-elevation	d.f.	p
A - B	4.734	1:404	<0.05	26.581	1:405	<0.001
A - C	0.718	1:317	>0.1	0.053	1:318	>0.1
A - D	8.203	1:367	≤ 0.005	504.219	1:368	<0.001

The distribution of individuals with different numbers of missing teeth in relation to age and dental care are illustrated in Fig. 10. This gives an idea of the differences in this respect between the different dental care groups.

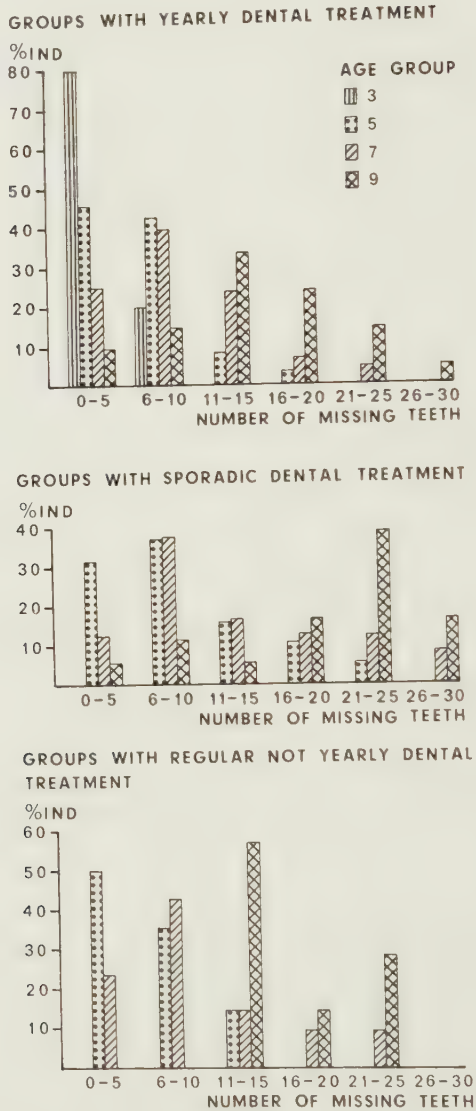


Fig. 10. Distribution of individuals with different numbers of missing teeth on age and dental care.

Total loss of maxillary teeth

Since teeth are lost at a higher rate from the maxilla than the mandible, some individuals who still retain mandibular teeth may be edentulous in the upper jaw. The distribution of such subjects has been considered and is shown in Fig. 11.

The incidence of edentulous maxillae was much higher in the sporadic dental care group than in the yearly one. When tested with chi-square tests the differences were found to be significant in age groups 6, 7 and 9.

Impacted teeth

The prevalence of impacted wisdom teeth decreased with increasing age from an average of .66 to .13 teeth per individual. The prevalence seemed to be related to age and not to the frequency of dental treatment.

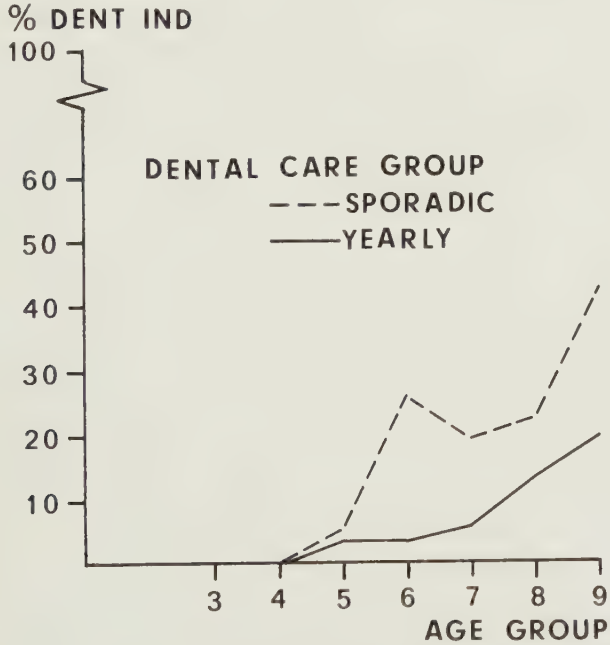


Fig. 11. Percentages of individuals with edentulous maxillae in relation to age and dental care.

Remaining teeth

The number of remaining teeth per individual in relation to age and dental care is reported in Table 13. For differences between groups see "Tooth loss".

The relationship between tooth loss and age follows a reasonably definite pattern, which gives the remaining types of teeth an age-dependent distribution (Björn 1971). The molar teeth suffer the earliest and heaviest losses, while premolars are intermediate, and incisors and especially canines show the least reduction in number.

Fig. 12 illustrates the composition of the remaining dentition in relation to age and dental care in the present material. At any age the sporadic dental care group had less remaining teeth of any type than the yearly dental care group. There was no significant difference between the groups receiving regular dental care, but the tendency at least in the higher age groups was to a stratification, with dental care group B (≥ 2 treatment periods/year) always showing a higher number of remaining teeth than group C (not yearly but regular dental care), with group A (= one treatment period/year) occupying an intermediate position.

Restored teeth

On an average 70 per cent of remaining teeth in this sample displayed some form of restorations. The variations between the age groups were small, Table 14, Fig. 13. However, a comparison between the means of the means per individual within the yearly and sporadic dental care groups revealed a lower average number of restored teeth in the sporadic group. The differences were significant within all separate groups except age groups 4 and 6.

About 90 per cent of posterior teeth in the yearly dental care group were restored, while the corresponding percentages for anterior teeth varied between about 50 and 60 per cent. These per-

Table 13. Number of remaining teeth per individual related to age and dental care.

Age group		3		4		5		6		7		8		9	
		mean	s.d	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Dental care gr.	A	28.1	1.78	26.3	3.23	24.9	4.12	24.1	5.06	22.0	4.84	19.7	7.53	16.4	7.26
	B	26.0	1.71	26.0	3.25	25.5	3.82	24.4	5.32	22.9	5.08	20.7	6.53	18.0	6.62
	C			27.6	2.01	25.4	3.71	25.0	5.14	22.0	5.73	18.4	7.37	15.4	4.65
	D			24.9	4.65	23.3	5.40	18.3	8.30	18.9	7.47	16.1	6.91	12.1	7.73

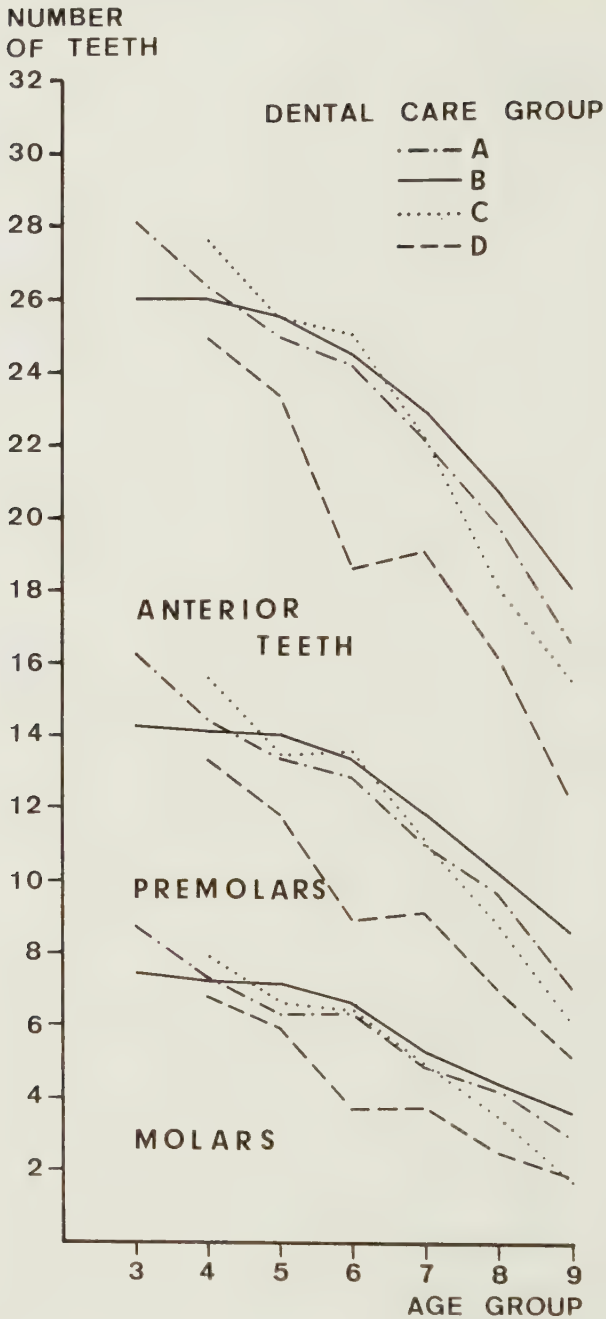


Fig. 12. Composition of the remaining dentition in relation to age and dental care.

Table 14. Restored teeth in yearly and sporadic dental care groups as percentages of remaining ones. (Mean ± standard deviation).

Age group	3		4		5		6		7		8		9	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Posterior teeth dental care														
yearly group	93.2	9.4	90.4	12.5	91.2	12.2	88.3	18.0	92.4	12.5	87.5	21.4	92.9	16.7
sporadic "			84.9	20.4	71.3	28.2	70.6	38.7	72.3	32.1	64.4	38.0	65.4	36.5
Anterior teeth dental care														
yearly group	53.4	26.0	46.1	27.7	50.0	25.2	50.2	29.1	57.2	25.9	55.3	26.4	62.6	35.0
sporadic "			47.5	39.4	39.2	29.5	58.4	32.5	38.7	30.2	39.6	33.3	36.4	39.2
All teeth dental care														
yearly group	76.0	14.2	70.3	16.6	72.2	16.1	71.0	19.2	74.8	16.7	71.5	18.1	75.6	24.6
sporadic "			68.3	26.5	55.8	25.2	67.9	25.7	55.9	24.5	52.9	31.6	46.4	33.5
Number of individuals dental care														
yearly group	35		9		61		94		88		59		21	
sporadic group			50		19		25		24		34		18	

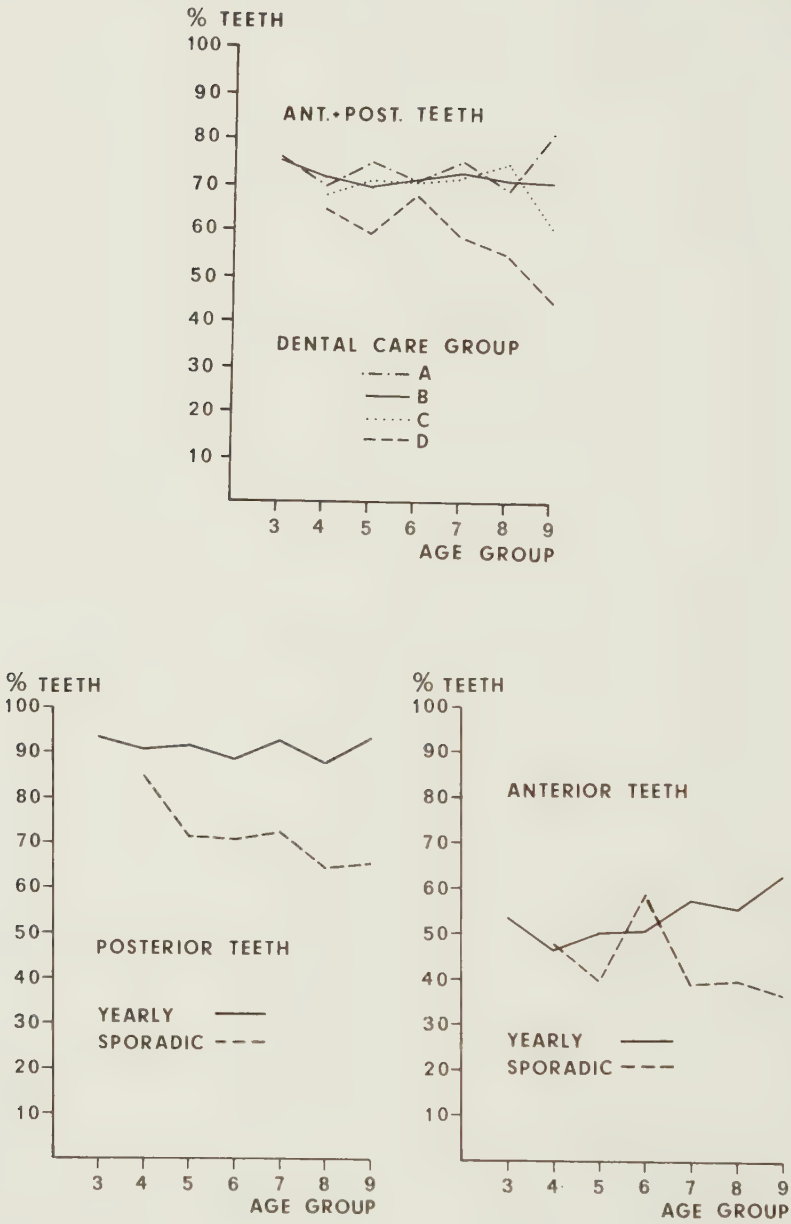


Fig. 13. Restored teeth as percentages of remaining teeth.

centages did not show any definite relation with age.

In the sporadic dental care group the percentages of restored posterior teeth decreased with increasing age from about 85 to 65 per cent. In this dental care group anterior teeth also displayed lower percentages of restored teeth, about 35 to 60 per cent.

Extent of restorations

The extent of radiopaque restorations was estimated from roentgen films. There was some difficulty in distinguishing between buccal and lingual fillings, and therefore, buccal and lingual surfaces were counted as one surface per tooth. Thus, four surfaces were recorded for posterior teeth, mesial, distal, occlusal and buccal-lingual. Only three surfaces were recorded for anterior teeth, on a similar basis.

Restored posterior teeth had on an average 2.5 to 3 restored surfaces and anterior teeth about 1.5 to 2 surfaces, Table 15. There were no considerable variations with age. Only molars displayed appreciable differences between dental care groups. The two yearly dental care groups had more restored surfaces per restored molar than the group with sporadic dental care habits. However, the differences were rather small.

Marginal fit of restorations on proximal surfaces

The proportions of proximal radiopaque restorations in molars and premolars displaying measurable overhangs and those displaying overhangs $\geq$0.2 mm. are shown in Fig. 14. The frequency of overhangs of the later size was studied previously by A-L Björn et al. (1969, 1970). These authors showed that the periodontal bone heights associated with overhangs of this dimension ($\geq$0.2 mm) were lower than those proximal to contralateral teeth where no overhangs were recorded.

Excess of restorative material $\geq$0.2 mm. was somewhat more fre-

Table 15. Average number of restored surfaces per restored tooth in relation to age and dental care.

Age group	3				4				5				6			
Dental care group	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Molars	2.6	2.6			2.5	2.6	2.2	2.1	2.6	2.6	2.5	2.4	2.6	2.6	2.7	2.3
Premolars	2.6	2.9			2.7	2.7	2.7	3.1	2.7	2.7	2.9	2.8	2.8	2.8	2.8	2.8
Anterior teeth	1.6	1.9			1.7	1.9	1.6	2.0	2.0	1.7	1.7	1.9	2.0	2.0	1.8	1.9

Age group	7				8				9			
Dental care group	A	B	C	D	A	B	C	D	A	B	C	D
Molars	2.7	3.1	2.8	2.3	2.8	2.8	2.8	2.5	2.9	2.9	2.6	1.5
Premolars	3.2	3.2	3.0	2.7	3.0	3.0	3.3	2.8	3.3	3.3	2.4	2.7
Anterior teeth	2.0	2.1	2.1	1.8	2.0	2.0	2.2	2.0	2.1	2.1	1.5	2.0

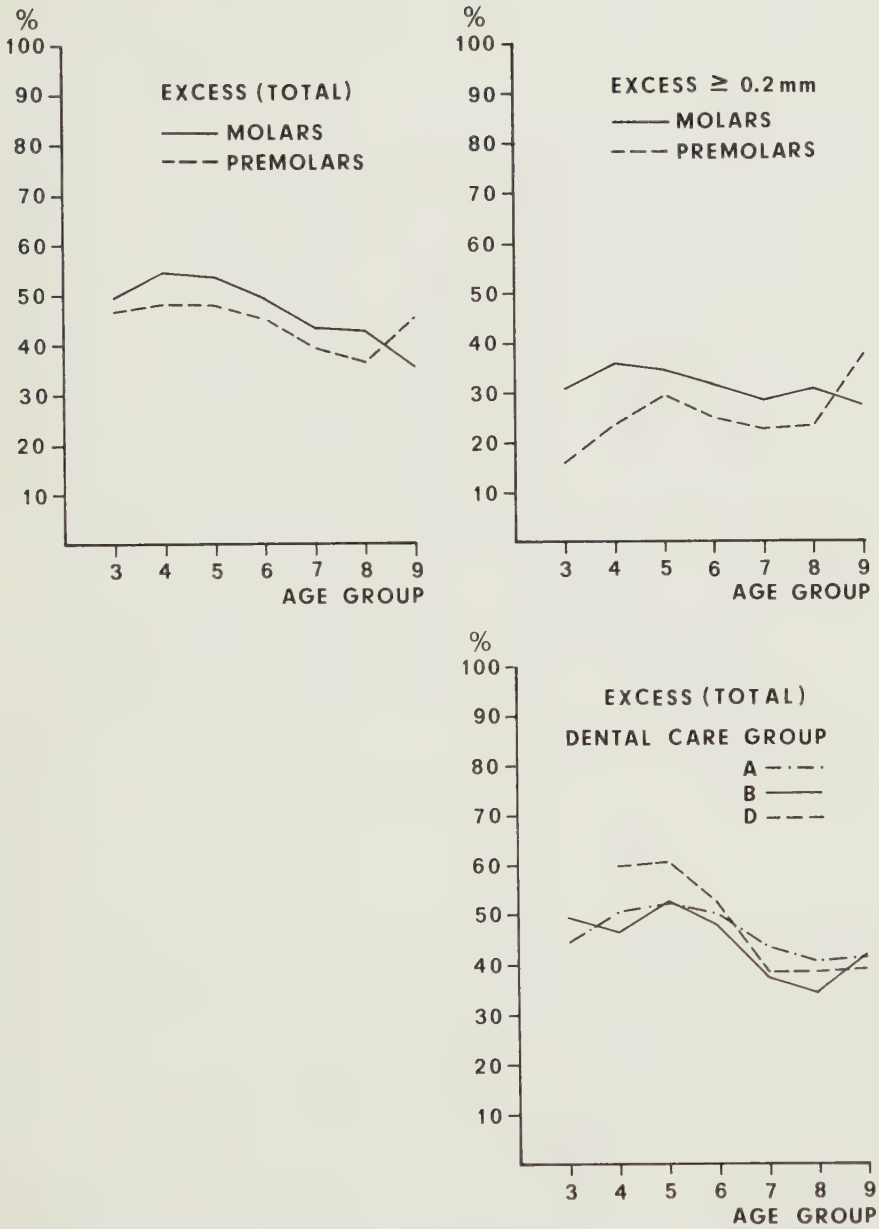


Fig. 14. Percentages of proximal restorations with excess of restorative material.

quent in molars than in premolars. No significant variations between age or dental care groups were apparent.

Endodontic treatment

The percentages of individuals with teeth that were endodontically treated are shown in Fig. 15. These percentages varied between 50 and 94 per cent, and were at a maximum in age group 7. They were further considerably and significantly higher in the yearly than in the sporadic dental care group ($p < 0.001$, all age groups comprised).

If only those individuals who had had endodontic treatment are considered, there were significant differences in the number of treated teeth per individual between the yearly and sporadic dental care groups only in the two highest age groups ($p < 0.05$ and < 0.001, Table 16).

The average percentages of endodontically treated teeth in relation to remaining ones in the total groups of individuals are given in Fig. 16. These percentages increased with increasing age in the yearly dental care group. They were fairly constant in the sporadic dental care group up to age group 8, but then showed a considerable decrease.

Caries

Caries in premolars and molars was scored on the basis of bitewing films. No clinical scoring was made, and thus only lesions on the proximal surfaces were considered.

In the anterior teeth, caries was scored using orthopantomograms and colour photographs. Consequently, caries in anterior teeht was not assessed with the same accuracy as caries in posterior teeth, and is therefore reported independently.

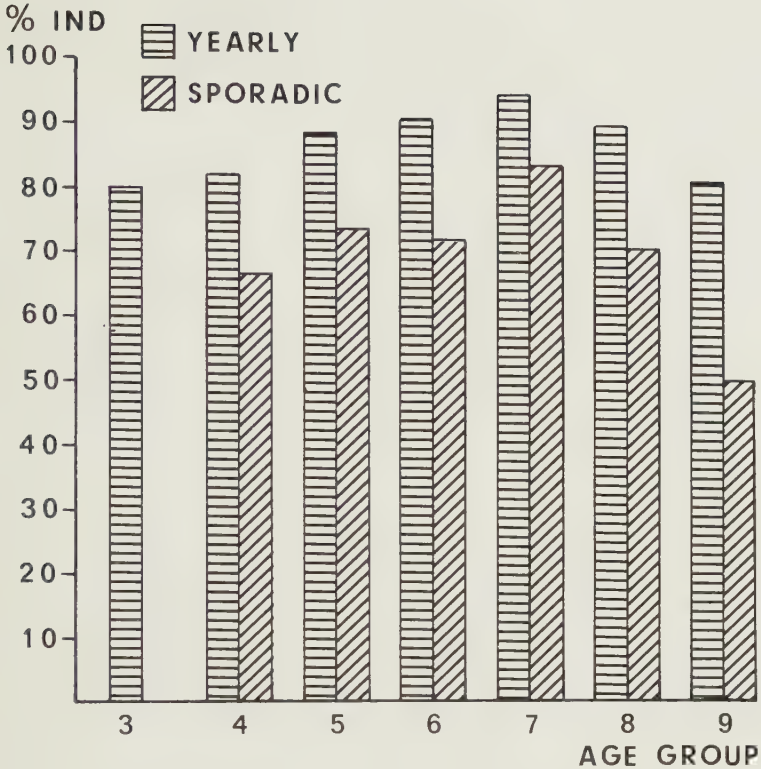


Fig. 15. Percentages of endodontically treated individuals in yearly and sporadic dental care groups.

Table 16. Mean number of endodontically treated teeth per individual. (Only endodontically treated individuals considered).

Age gr.	N	mean	s.d.	N	mean	s.d.
	Yearly			Sporadic		
3	28	2.6	1.5			
4	41	3.6	2.5	6	4.7	2.2
5	54	3.8	2.8	14	4.4	2.5
6	85	3.8	2.8	18	3.8	3.0
7	83	4.8	3.2	20	3.7	2.3
8	53	4.6	2.5	24	3.4	2.4
9	17	4.7	3.0	9	1.3	0.7

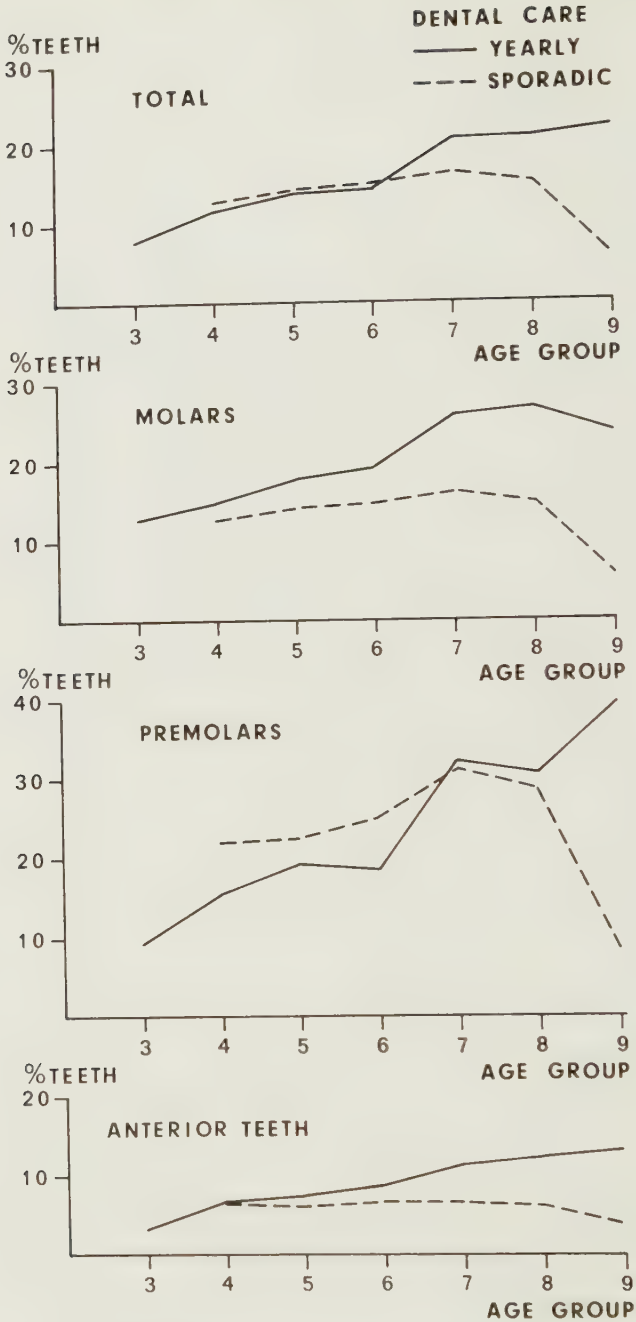


Fig. 16. Average percentages of endodontically treated teeth in relation to remaining ones.

Incipient carious lesions which only engaged the enamel were considered difficult to define clearly. For this reason, only those lesions which also caused a radiolucency in the dentine are reported below. The results of double readings showed that this limitation resulted in reproducible figures.

Caries in relation to dental care

The average percentages of carious lesions with dentine or cement engagement in the remaining posterior and anterior teeth respectively, in relation to dental care, are given in Fig. 17. For both categories of teeth the percentages were higher in the group with sporadic dental treatment than in groups with regular dental care.

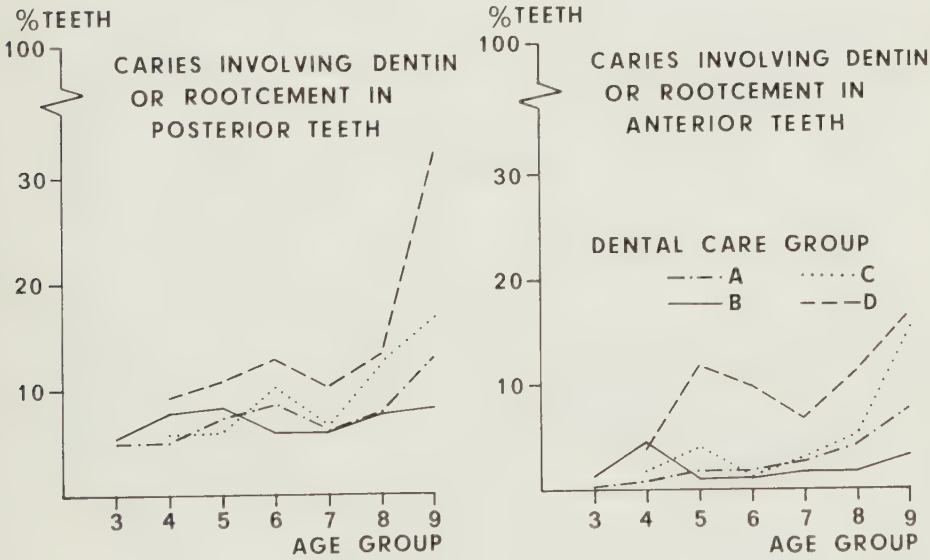


Fig. 17. Average percentages of carious lesions in remaining teeth in relation to dental care.

A study was made of the different types of caries in posterior teeth in order to get a clearer idea of the differences between the dental care groups.

Proximal caries in molars and premolars

The percentages of primary and secondary caries in relation to the numbers of proximal surfaces are presented in Fig. 18 a - d. The proportions of surfaces with primary caries are related to the numbers of present surfaces without restorations, while the proportions of surfaces with secondary caries are related to the numbers of surfaces with restorations. Dental care groups A and B did not show any appreciable differences.

There were no significant differences between the yearly and sporadic dental care groups in the frequency of primary caries, Fig. 18 a and b. When all age groups were considered jointly the sporadic dental care group had a somewhat higher proportion of surfaces with secondary caries ($p < 0.025$), Fig. 18 c. "Deep" secondary caries with evident or suspected pulp involvment was more common in the sporadic than in the yearly group ($p < 0.05$), Fig. 18 d.

Cement caries

Caries involving root cement is presented as percentages of carious teeth in relation to remaining ones, Fig. 18 e. Significantly higher frequencies are displayed in the sporadic dental care group ($p < 0.001$).

Intact teeth

The means of the individual numbers of intact teeth are represented in Fig. 19. There was no clear difference between the dental care groups. Therefore, the percentages of individuals with ≤ 2 and > 8 teeth respectively were computed (Fig. 20). These numbers

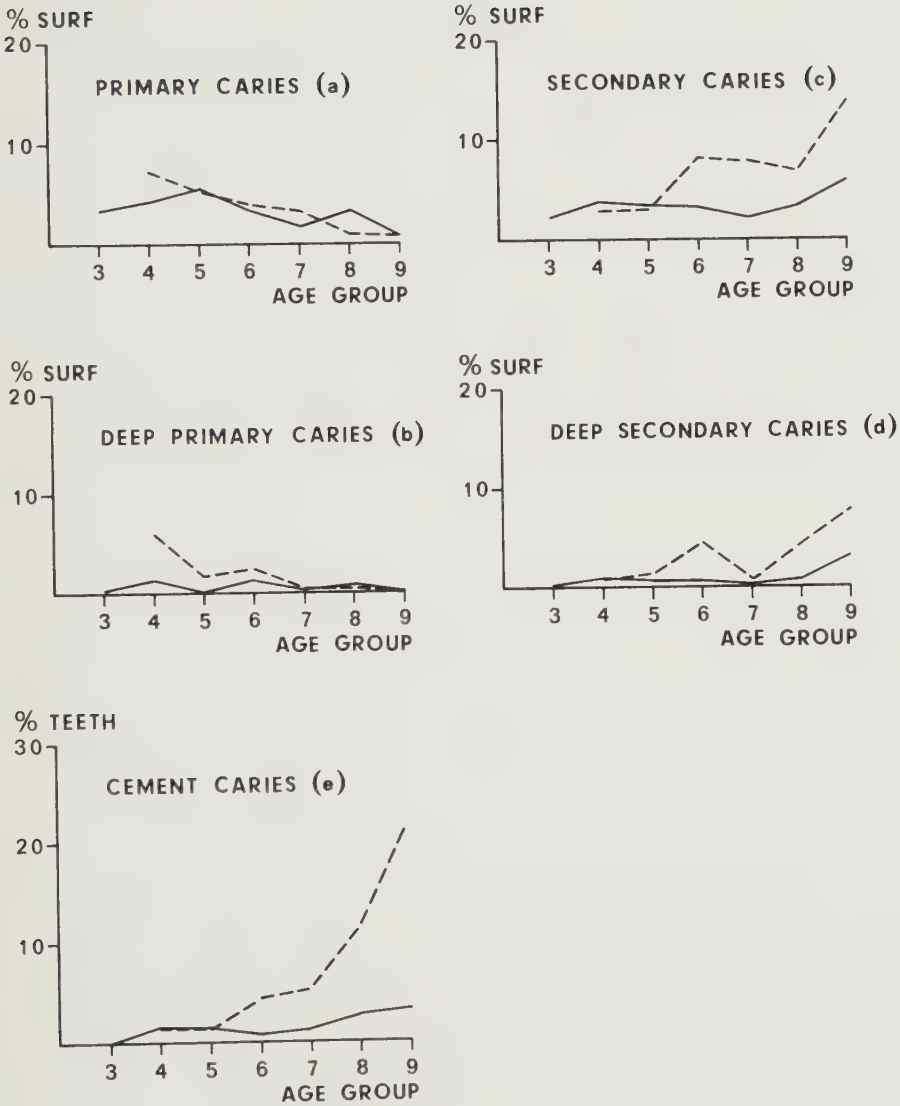


Fig. 18. Average percentages of primary, secondary and cement caries in posterior teeth.

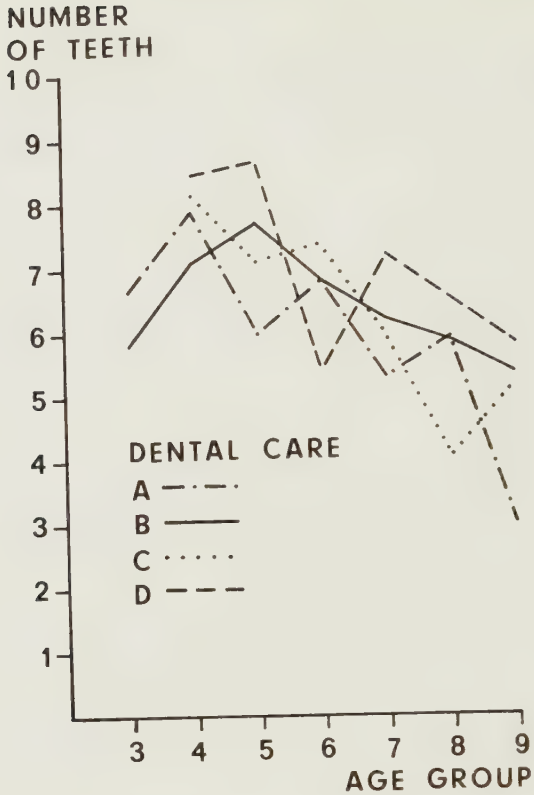
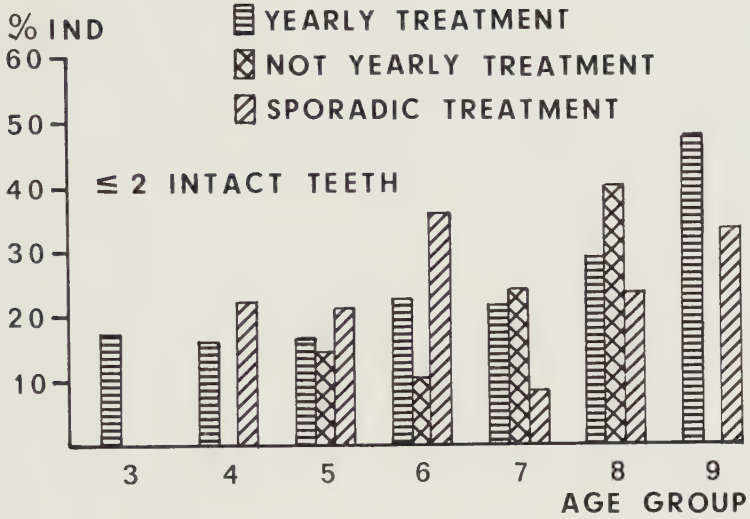


Fig. 19. Number of intact teeth per individual related to age and dental care.

are arbitrary but may to some degree be useful for demonstrating the proportion of individuals with a higher and a lower susceptibility to dental disease. The bar diagrams display no definite tendency for any of these "susceptibility" groups to dominate within any of the dental care groups.

Periodontal index

The distribution of the score units on age is represented in Fig. 21 for the totality of remaining teeth as well as for molars, premolars and anterior teeth separately. On an average 0 - 1.5 per cent of the teeth were assigned score 8. Because of this low percentage scores 6 and 8 were added.



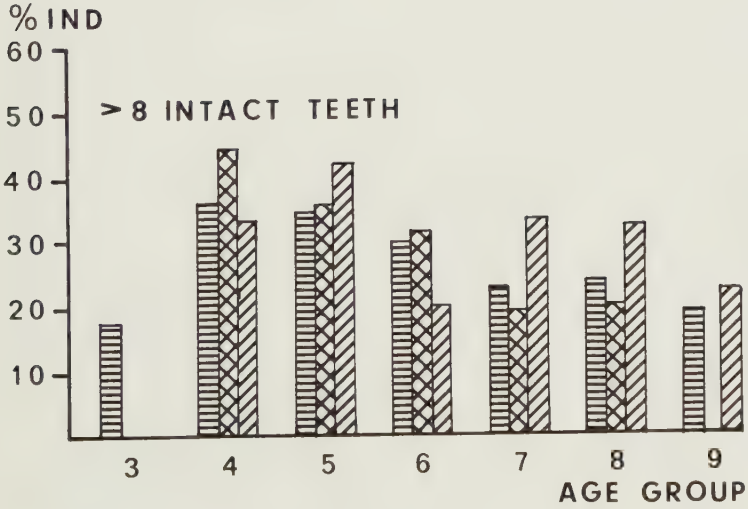


Fig. 20 Percentages of individuals with ≤ 2 and > 8 intact teeth.

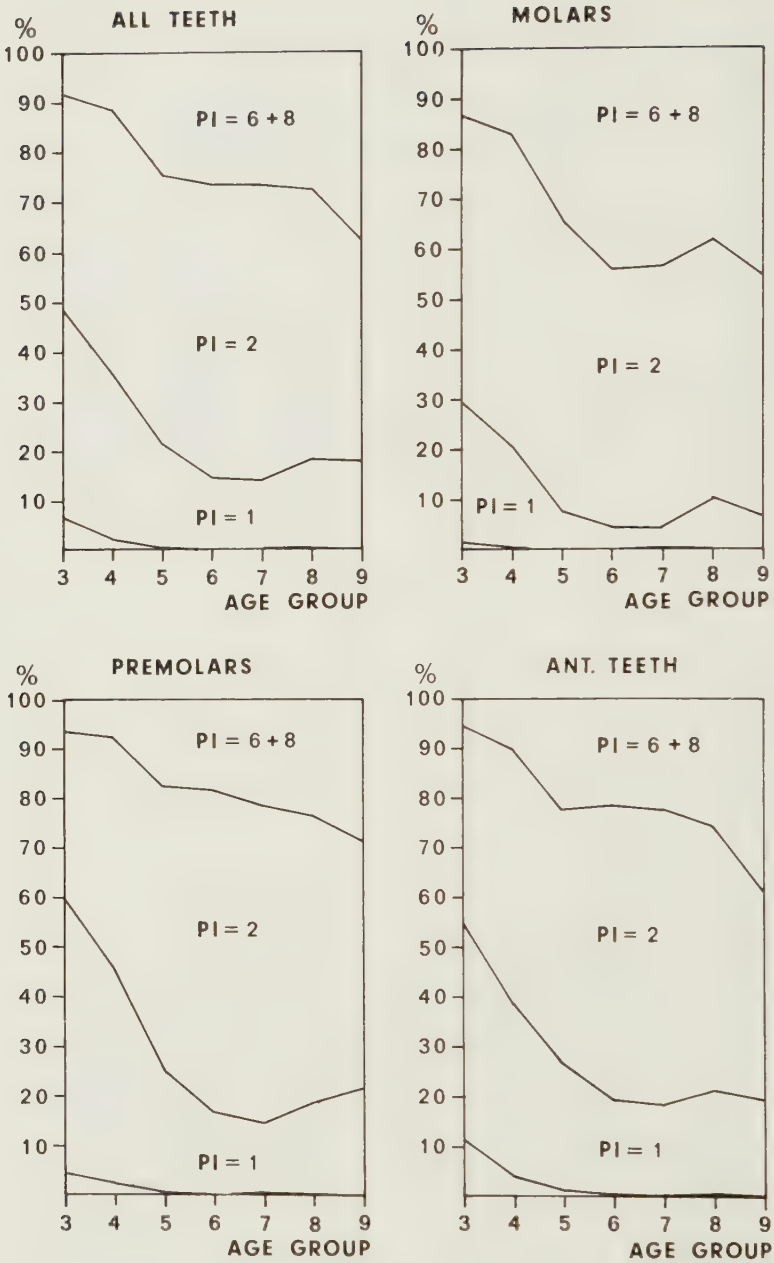


Fig. 21. Distribution of P I scores in different regions of the dentition. (The small unmarked areas in the lower parts of the diagrams represent score 0.)

A marked rise in the proportion of high score values with age is evident in all the diagrams. Previous epidemiological studies (Freedman et al. 1965, Ainamo 1970 among others) have shown that the molar areas display worse periodontal conditions than other parts of the dentition. This view was corroborated by the present investigation, where about 40 per cent of the remaining molars from the age of 40 years on were scored with P I 6 or 8.

That the proportion of P I = 0 was so slight throughout may be explained by the fact that the scoring was made by periodontologists trained in using rather strict criteria for "no inflammation".

P I in relation to dental care

According to Russell (1956) the results of P I assessments in epidemiologic investigations should be presented as means of the mean scores for each individual. In order to make comparisons with other studies possible such means were also calculated in the present study, Fig. 22.

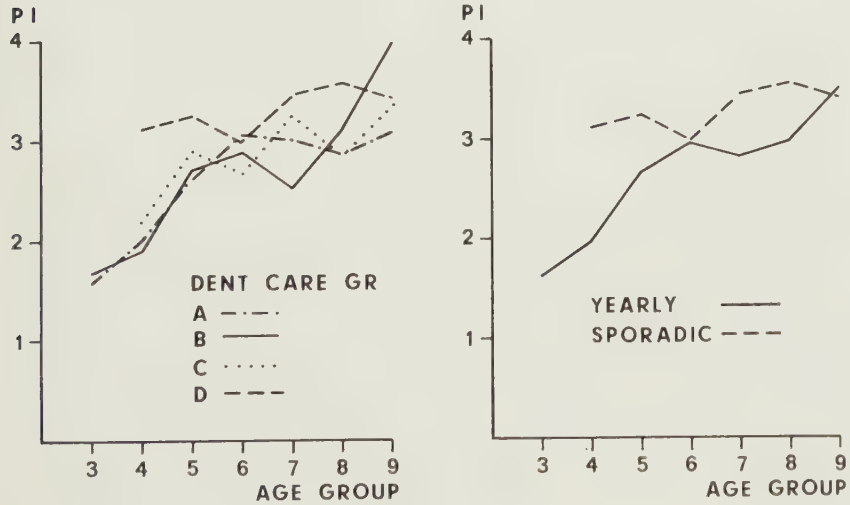


Fig. 22. Mean P I scores related to age and dental care.

The P I means were found to increase with increasing age which is in agreement with the findings in previous studies (Jamison 1960, Russell 1964, Waerhaug 1966 and others). The increase is most apparent in the yearly dental care group. There is, however, a significant difference between the yearly and sporadic dental care groups only in age group 4.

The distribution of individuals with an average P I score within certain limits is given in Fig. 23. According to Russell "established periodontal disease" prevails if the average P I score exceeds 1.5. In the present study the proportion of individuals with mean scores below this limit was small except in the youngest age groups of the yearly dental care group. There were no significant differences between the yearly and sporadic dental care groups in comparable age groups (chi-square analyses).

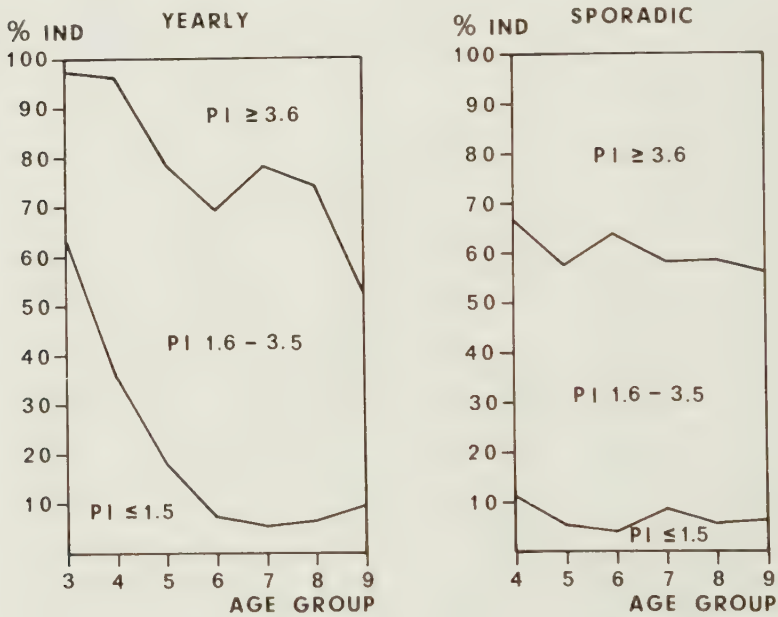


Fig. 23. Distribution of individuals with mean P I scores within certain limits.

The proportion of individuals with P I means exceeding 3.5 was considerably greater in the sporadic dental care group in all age groups except group 9 $p < 0.01$, series of 2 x 2 tables, (S.& C.) . Thus, advanced periodontal disease was more common within the sporadic dental care group in which about 40 per cent of the individuals displayed P I means exceeding 3.5.

Means of mean percentages per individual of teeth with P I scores ≥ 6 are shown in Fig. 24. The similarity of the curves obtained with those depicting mean P I scores (Fig. 22) is conspicuous.

Fig. 25 shows the percentages of individuals with 0 and >50 per cent respectively of remaining teeth which were assigned P I scores ≥ 6. When individuals with >50 per cent teeth displaying scores of this size were considered, significant differences between the yearly and sporadic dental care groups were observed for all age groups joined as well as for age groups 4, 5 and 7 separately ($p < 0.02$).

Periodontal bone height proximal to molars and premolars

As described above, assessment of proximal bone heights was made only in the mandibular molar and premolar regions. The mean bone scores based on means per individuals are reported in Fig. 26. Within each dental care group the alveolar bone loss increased with increasing age. This is in accordance with previous studies, e.g. Belting et al. (1953), Marshall-Day et al. (1955), Schei et al. (1959), Engelberger et al. (1970) and Björn (1971). At a comparison between the yearly and sporadic dental care groups the differences were small, at a maximum amounting to .4 scale divisions (i.e. 4 per cent of the total tooth length).

Regression and covariance analyses were performed, taking into account the fact that the standard deviation also in this case was proportional to the age, Fig. 27 (cf. "Tooth loss"). Slight but

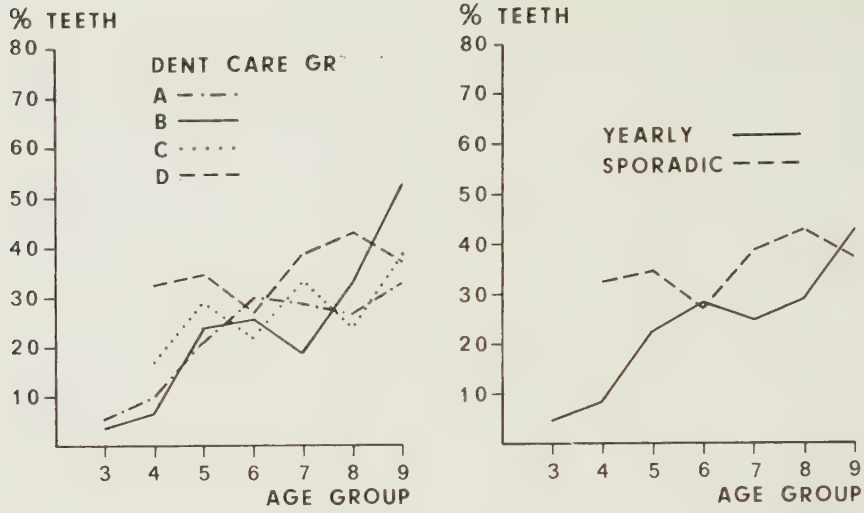


Fig. 24. Means of mean percentages per individual of teeth with P I scores ≥ 6.

Fig. 25. Distribution of individuals with 0, 1-50 and > 50 % of remaining teeth assigned P I scores ≥ 6.

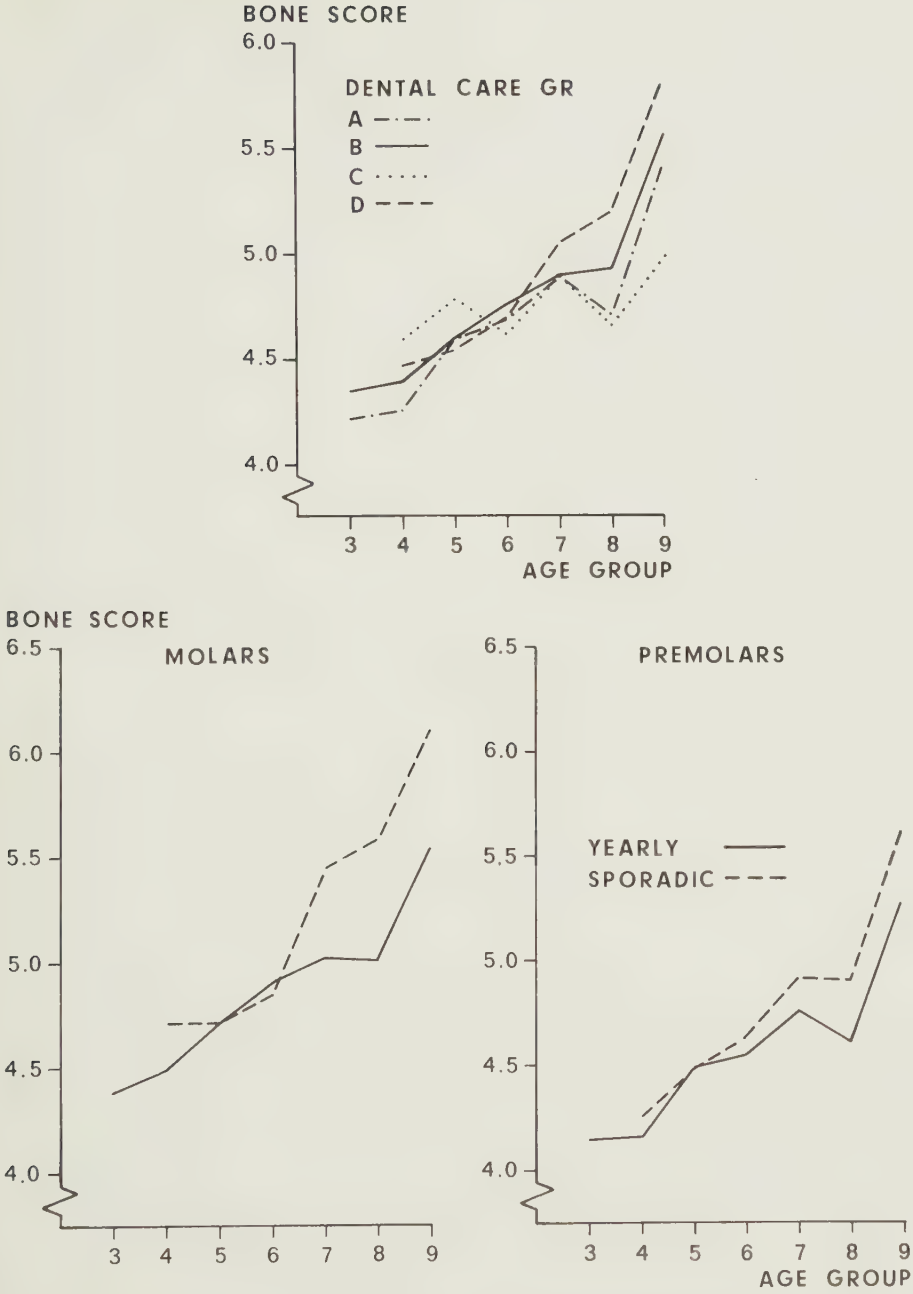


Fig. 26. Mean bone scores related to age and dental care.

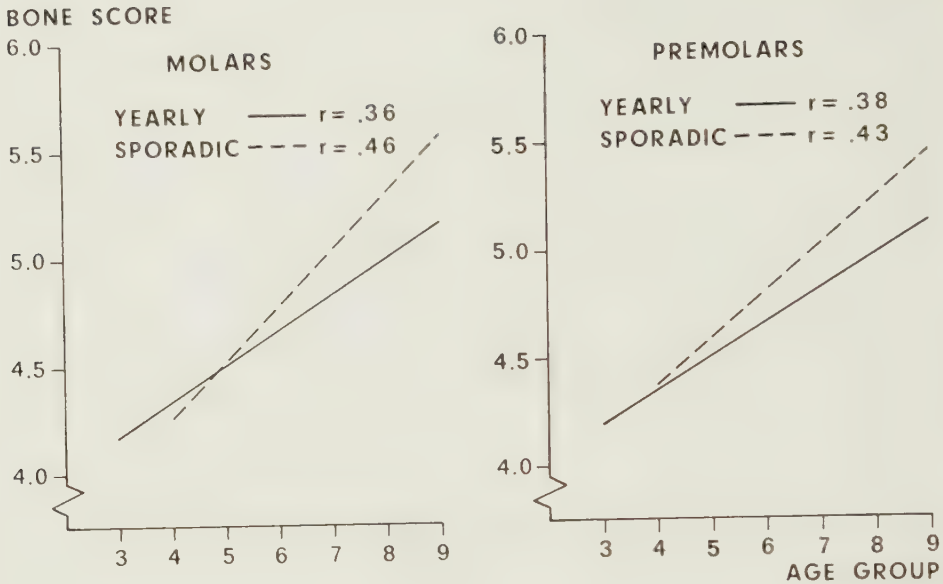


Fig. 27. Regression of mean bone scores on age.

significant differences between the yearly and sporadic dental care groups were observed for molars and premolars separately as well as combined.

When each age group was tested separately with the t-test for independent variables no statistically significant differences between the dental care groups were found for molars and premolars combined (Table 17).

Fig. 28 illustrates the average percentages of teeth with bone score ≤ 4. This score implies that no or a negligible bone resorption has occurred. The percentages decreased with increasing age within all dental care groups.

The percentages of individuals with mean bone scores ≤ 4, 4.1 - 5 and >5 are exemplified in Fig. 29. There were no statistically

significant differences between yearly and sporadic dental care groups.

Table 17. Mean bone scores related to age and dental care. Mandibular molars and premolars.

	Yearly			Sporadic		
Age groups	N	mean	s.d.	N	mean	s.d.
3	35	4.26	.23			
4	50	4.29	.32	9	4.42	.34
5	61	4.55	.44	19	4.52	.46
6	93	4.68	.53	23	4.65	.45
7	88	4.85	.65	22	5.02	.55
8	56	4.77	.51	30	5.17	1.15
9	20	5.50	1.01	17	5.84	1.36

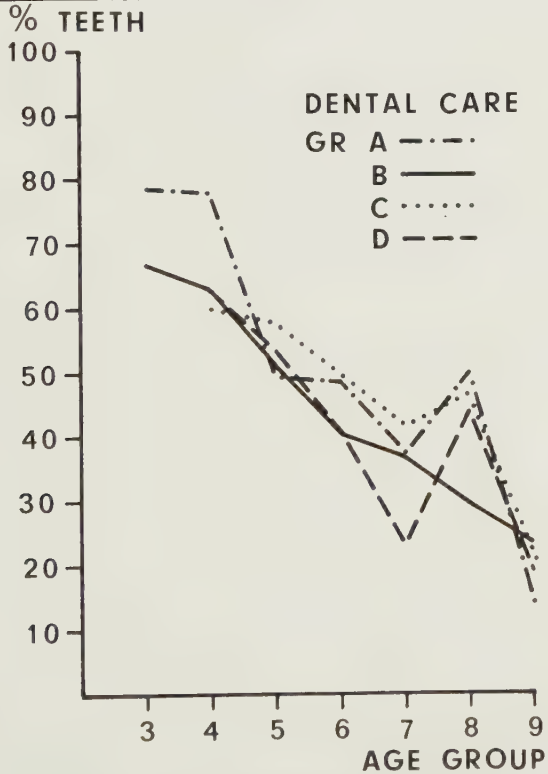


Fig. 28. Percentages of teeth with bone score ≤ 4 related to age and dental care.

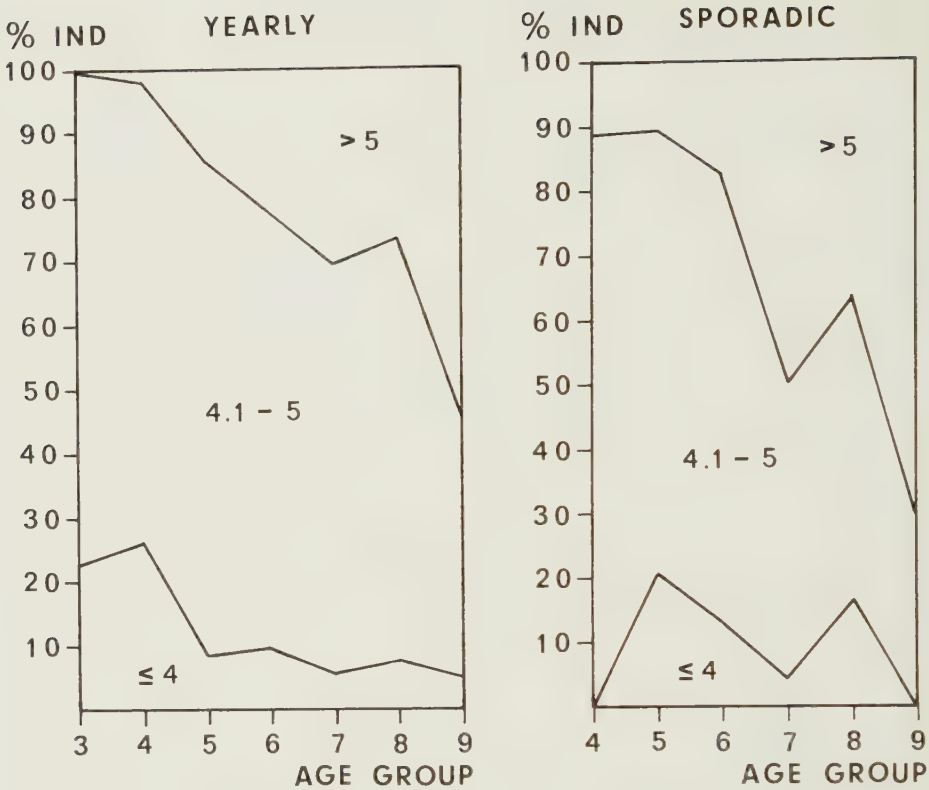


Fig. 29. Percentages of individuals with mean bone scores ≤ 4, 4.1-5 and > 5.

Proximal calculus on molars and premolars

The percentages of teeth showing proximal calculus are given in Fig. 30. Calculus was diagnosed on about 30 per cent of the premolars and on between 50 and 60 per cent of the molars. No definite variations with age were noted.

Between 80 and 90 per cent of the individuals had mineralized deposits on one or more teeth (Fig. 31). There were no significant differences (chi-square analyses in series of 2 x 2 tables) in the number of individuals with calculus between the groups. The average percentages of teeth with calculus was greater in the group with sporadic than in that with yearly dental care (Fig. 32).

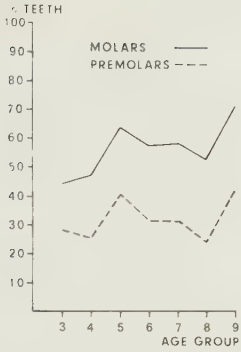


Fig. 30. Percentages of molars and premolars with proximal calculus.

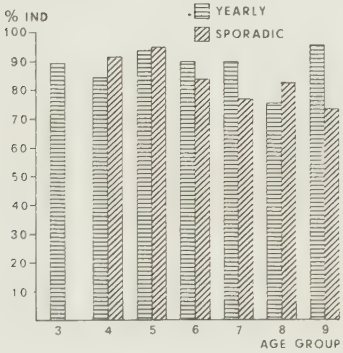


Fig. 31. Percentages of individuals with proximal calculus.

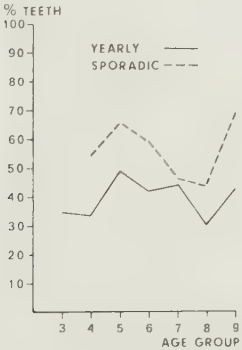


Fig. 32. Percentages of teeth with proximal calculus.

Supragingival calculus on mandibular incisors

At the clinical examination the amount of supragingival calculus on the lingual surfaces of the mandibular incisors was noted by aid of the index described in the chapter on "Methods".

The results are shown in Fig. 33 which shows the percentages of individuals within the yearly and sporadic dental care groups, which displayed a calculus index >1. The yearly dental care group had less calculus than the sporadic one. There was a considerable and statistically significant difference between these dental care groups in age groups 5 to 7. ($p<0.05$, $p<0.05$, $p<0.005$).

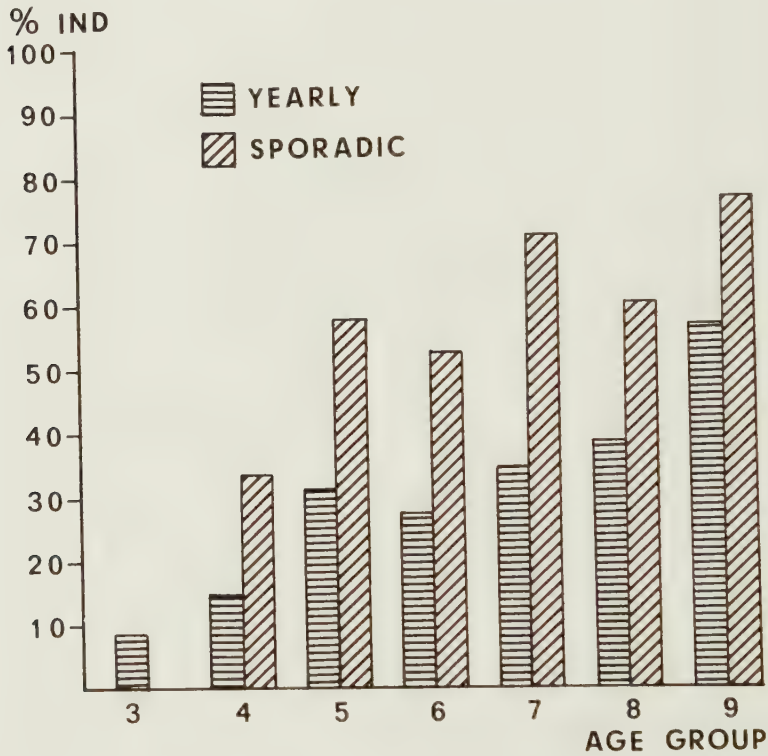


Fig. 33. Percentages of individuals with supragingival calculus covering $>1/4$ of the lingual surfaces of mandibular incisors.

CHANGES IN DENTAL HEALTH CONDITIONS BETWEEN 1965 AND 1971

A longitudinal investigation may provide some idea of the influence of present-day dentistry on the dental health condition within a population. The longitudinal approach has been utilized above all in experimental studies, e.g. research on the effect of water fluoridation or of sucrose on caries activity, on the effect of mechanical or chemical plaque control etc. Research of this type may give relatively clear-cut answers to the questions put forward.

The difficulties are far greater in longitudinal studies of groups that cannot be subjected to the strict and uniform conditions of an experiment. In such groups the dental health state is influenced by a multitude of factors, many of which have little to do with the initiation and progress of dental and periodontal disease per se.

Above all, the indications for treatment used by different dentists and variations in their skill may have an effect on the dental state. The patients also probably have a strong influence on the choice of therapy and as a result many non-dental criteria may decide the final therapy. This may be of particular importance to extractions and restorations.

The continous development of dentistry, with new materials and methods, may also influence to an unknown degree the conditions of the teeth at different ages of a persons lifetime. Such factors may certainly affect the figures arrived at for missing teeth, or the number of restored teeth, to refer to the same items of everyday dentistry. Therefore, it is impossible to know for certain to what degree such figures depict dental disease, and to what extent they are the result of varied therapy.

The interpretation of figures for periodontal bone height, subgingival calculus, and gingival inflammation is easier, since

those parameters are directly correlated to the type and intensity of dental prophylaxis and treatment.

A corresponding measure of the effect of preventive steps against dental disease can be found in the number of teeth, or tooth surfaces, remaining intact during the period.

An evaluation of the influence of dental care on the dental health along these lines, only takes into consideration the effects on certain aspects of dental health. That part of odontological therapy which aims at the maintenance of physiological and esthetic features will not be discussed below, in spite of its great significance in modern dentistry.

RESULTS

The changes that have occurred during the six years that elapsed between the two examinations are reported in the same order as the findings reported above, i.e. missing and filled teeth and periodontal bone height. Comparisons of the caries status in 1965 and 1971 could not be made since bite-wing roentgenography was not carried out in the 1965 examination.

Tooth loss

In the 637 dentate participants 729 teeth were lost during the interval; 299 molars, 172 premolars and 258 anterior teeth. In addition, 6 teeth which were impacted in 1965 had been removed; 4 in age group 3 and 2 in age group 4. These impacted teeth are not included in the report below.

The average number of lost teeth per individual increased with increasing age, which is shown in Fig. 34 together with the distribution of the number of lost molars, premolars and anterior teeth.

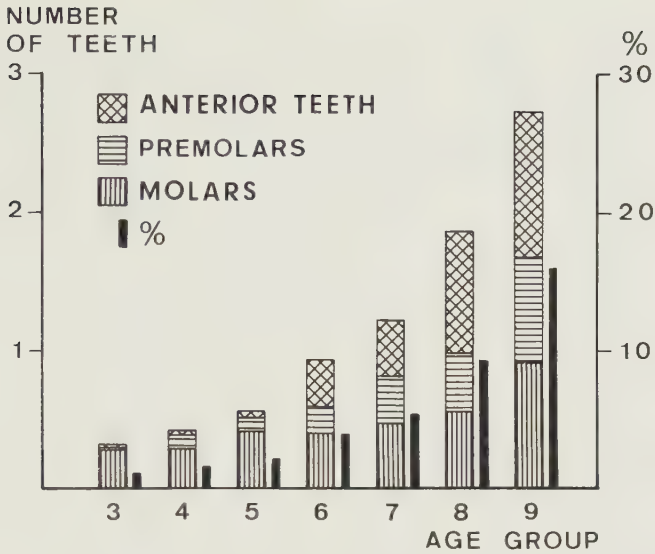


Fig. 34 Average number of lost teeth per individual during the interval 1965-1971.

▌% denotes percentages calculated on the number of remaining teeth.

Fig. 35 Percentage distribution on age and dental care of individuals having lost teeth during the interval.

The incidence of lost teeth may also be expressed as percentages in relation to the number of remaining teeth (in 1965), and these also increased with increasing age (Fig. 34).

The percentages of individuals having lost teeth during the period were higher in the sporadic than in the yearly dental care group ($p < 0.02$, sets of 2 x 2 tables), Fig. 35.

The average number of lost teeth per individual, and lost teeth as percentages calculated on remaining teeth (1965) were also higher in the group with sporadic treatment. This is relevant for the total group as well as for the group of individuals who had lost teeth between 1965 and 1971 (Fig. 36).

The type of teeth lost showed no clear relationship to the dental care frequency (Fig. 37). The percentages of wisdom teeth and first + second molars decreased while the percentages of anterior teeth increased with increasing age.

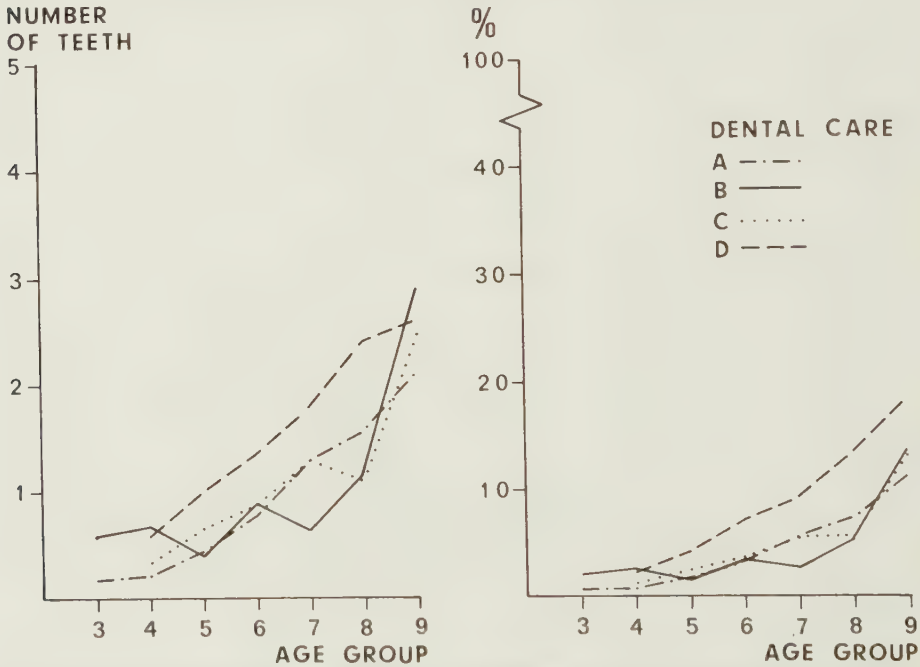


Fig. 36. Average numbers and percentages of lost teeth per individual related to age and dental care.

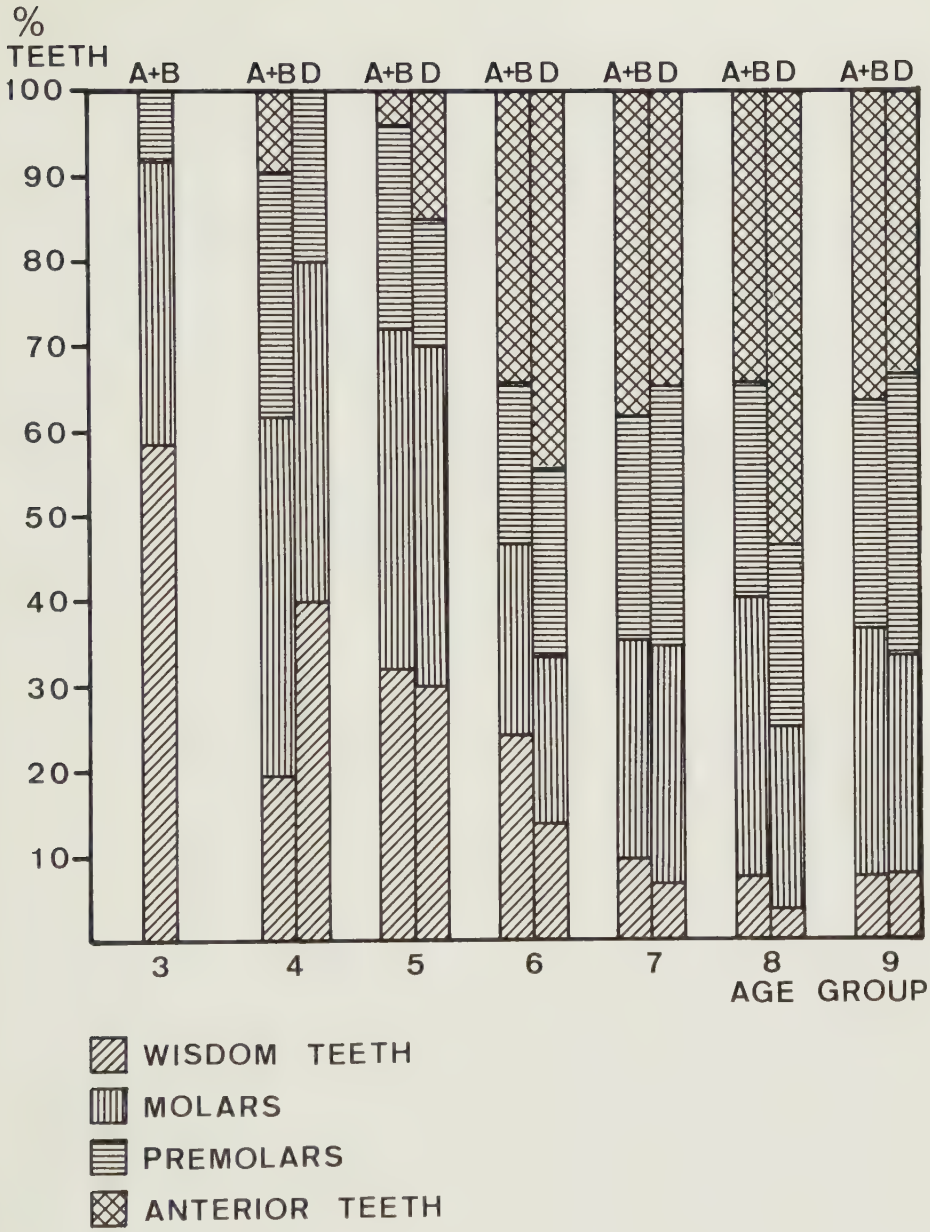


Fig. 37. Distribution of different types of lost teeth on age and dental care.

The condition in 1965 of teeth lost during the interval 1965 to 1971

Whether the indications for extraction varied between the dental care groups cannot be established retrospectively. Some idea of these indications may, however, be obtained from the condition of the extracted teeth at the examination in 1965. The distribution of restored, carious and intact teeth that were extracted is shown in Fig. 38 in relation to age and dental care. (The few anterior teeth and premolars that had been lost in age group 3 and 4 were all restored).

Restored teeth

The majority of the extracted teeth were restored. The size of the restorations may have been a deciding factor for the choice of the extraction therapy. Fig. 39 shows the average numbers of restored surfaces per extracted and per remaining tooth. The figures were calculated on the basis of observations from the first (1965) examination. The differences were rather small as far as molars and premolars were concerned while in the lower age groups, extracted anterior teeth seemed to have had somewhat more extensive restorations than the remaining ones.

Intact teeth

The distribution of extracted teeth that at the examination in 1965 were diagnosed as "intact", i.e. had no fillings, nor caries extensive enough to be diagnosed on orthopantomograms or colour photographs, is also shown in Fig. 38. In age group 3 about 30 per cent of extracted teeth were intact, especially third molars, while in the higher age groups the extraction of intact anterior teeth increased considerably. Higher percentages of intact premolars and anterior teeth were observed in the sporadic dental care group than in the yearly one. The differences were significant in age groups 7 to 9.

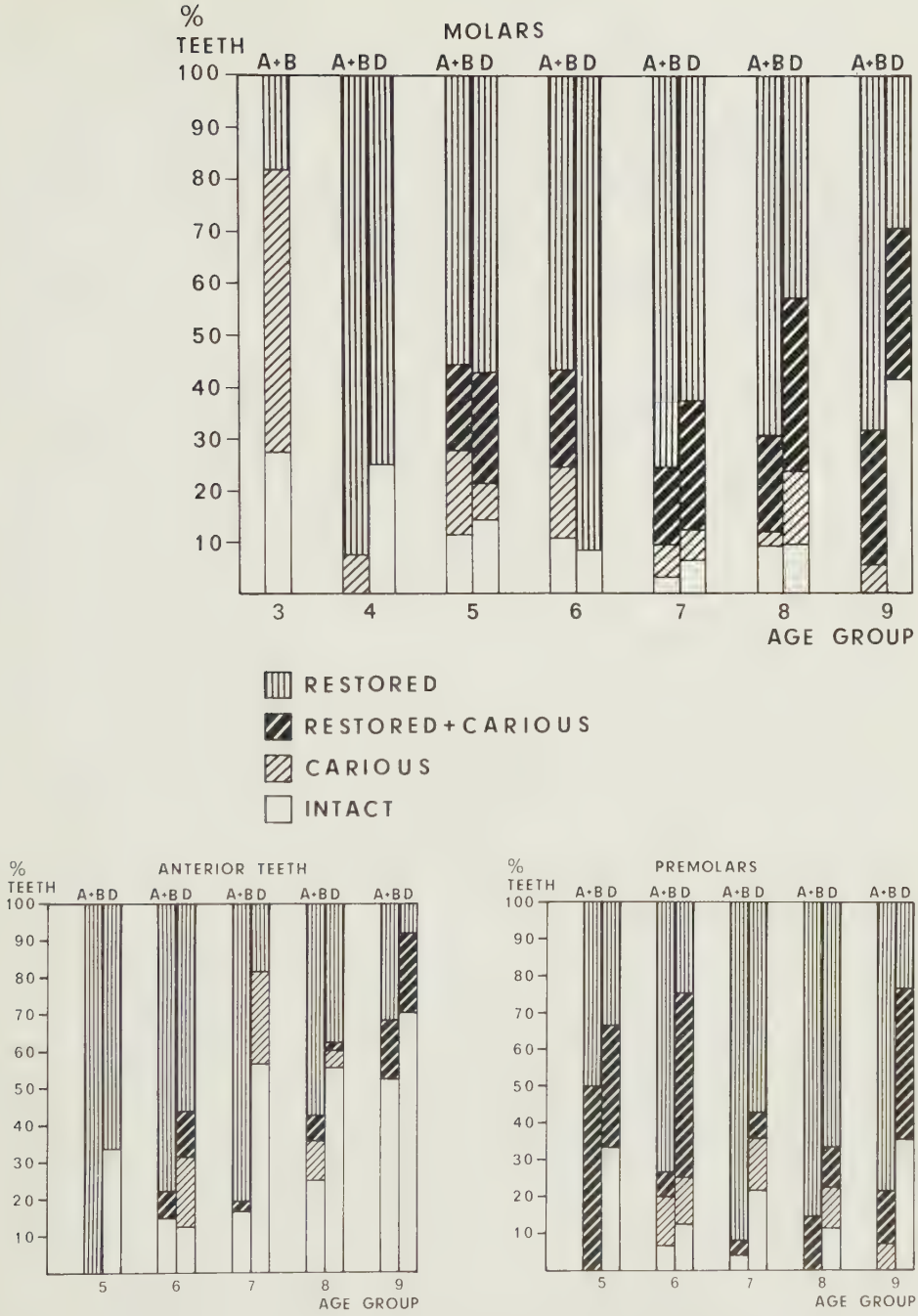


Fig. 38 Distribution of restored, carious and intact extracted teeth.

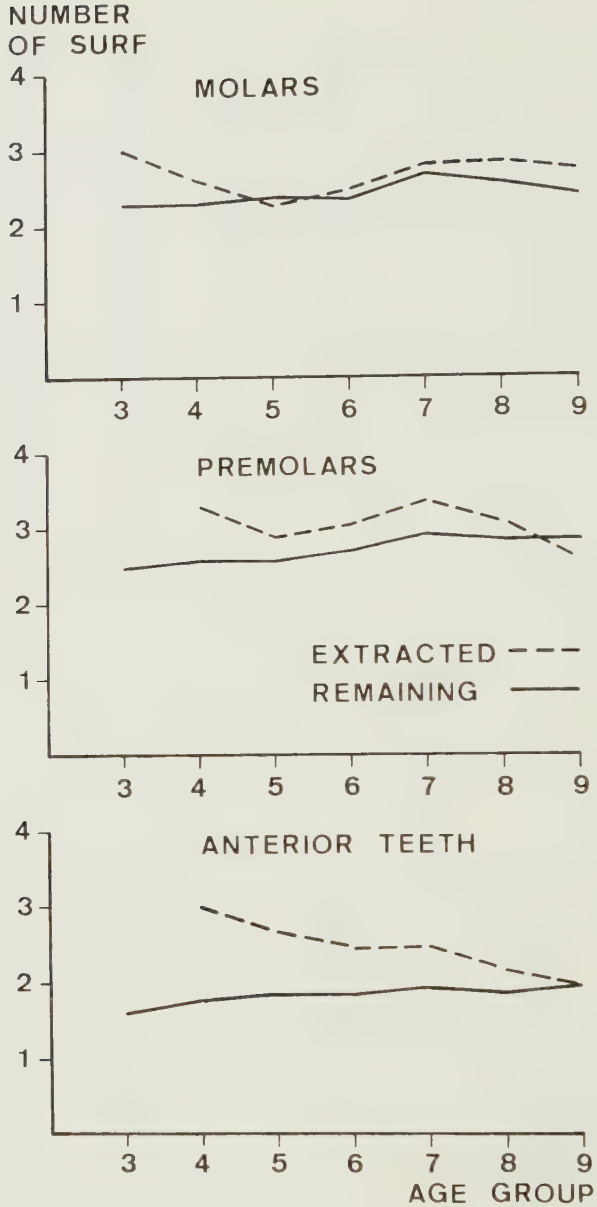


Fig. 39. Number of restored surfaces per lost and remaining tooth.

Bone scores in 1965 proximal to mandibular molars and premolars lost during the interval 1965 - 1971

In all, 213 mandibular molars and premolars were lost during the interval 1965 to 1971 (143 molars and 70 premolars).

The means of the mean for each individual of bone scores for lost teeth were compared with those from remaining teeth in individuals having had teeth lost during the period (Fig. 40).

Throughout the age groups bone scores were higher for lost than for remaining teeth in both the yearly and the sporadic dental care groups. t-tests for independent samples ($S_1 \neq S_2$) show that most of these differences were significant within age groups 6 to 9. (Age group 6 comprised individuals who in 1965 were 40 to 45 years old).

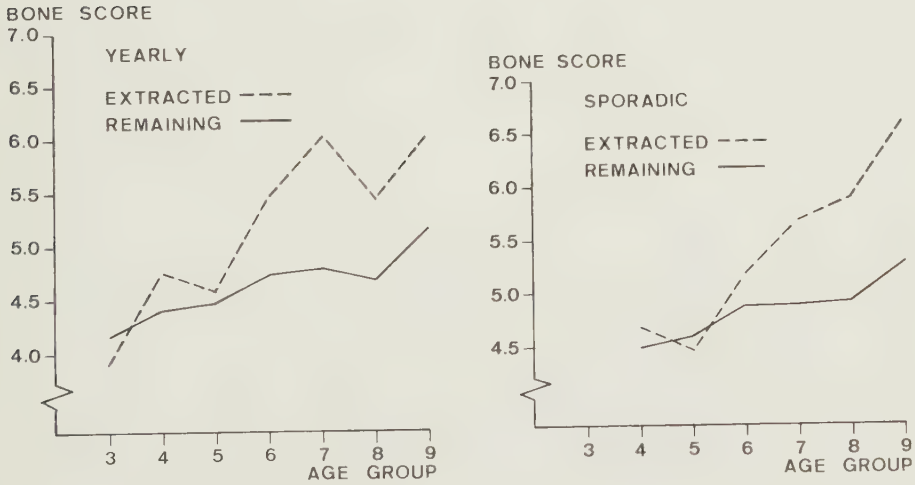


Fig. 40. Bone scores proximal to lost and remaining teeth.

Restorations 1965 - 1971

In the following only teeth that were present in both 1965 and 1971 are considered. Thus, throughout, the same teeth in the same individuals are compared.

Only restorations made during the observation interval on surfaces which were not restored at the examination in 1965 were recorded as "new". A certain underscoring occurred, since (as above) the buccal and lingual surfaces were considered together, and only four surfaces have been scored on posterior and three on anterior teeth.

An evaluation of restorative therapy along these lines shows that on an average 7.5 to 10.5 per cent of the surfaces free of restorations in 1965 had been treated during the interval (Fig.41). There were no considerable variations between age groups.

The average numbers of newly restored surfaces per individual also appear in Fig. 41. The highest numbers (about 6 surfaces) occurred in the lowest age group. In the other age groups there was a fairly constant number (about 3 to 4 surfaces).

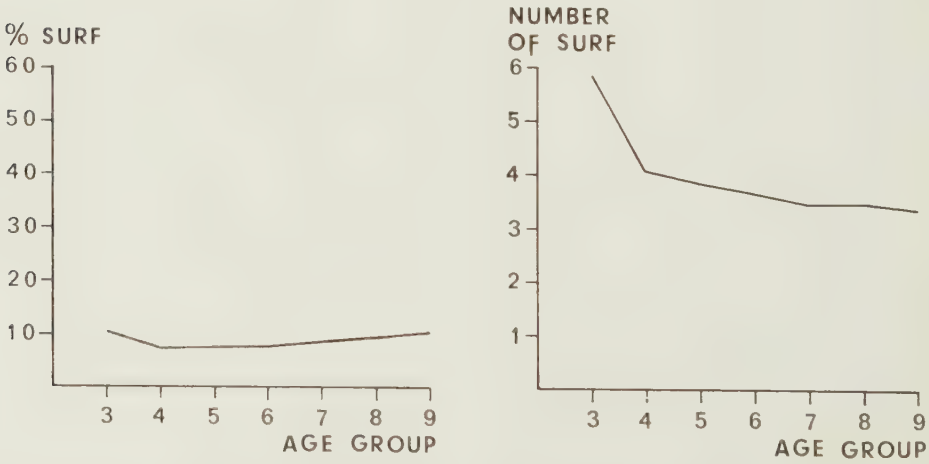


Fig. 41. Numbers and percentages of surfaces with "new" restorations. (Percentages calculated on the numbers of unrestored surfaces in 1965).

About 40-50 per cent of the individuals in the yearly dental care group had "new" restorations in contrast to appreciably lower percentages in the sporadic group ($p < 0.002$), Fig. 42.

The frequency of new proximal restorations in anterior and posterior teeth are reported separately, (Fig. 43). It is evident that the majority of new proximal restorations were made in posterior teeth.

The mean percentages were higher within the yearly dental care group (A and B) as far as posterior teeth were concerned, while the differences between dental care groups were less when anterior teeth were considered.

The average percentages of new buccal/lingual restorations did not differ appreciably between the dental care groups.

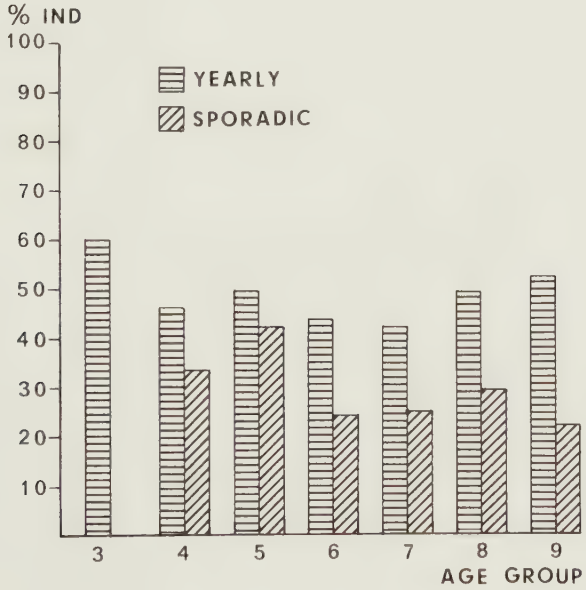
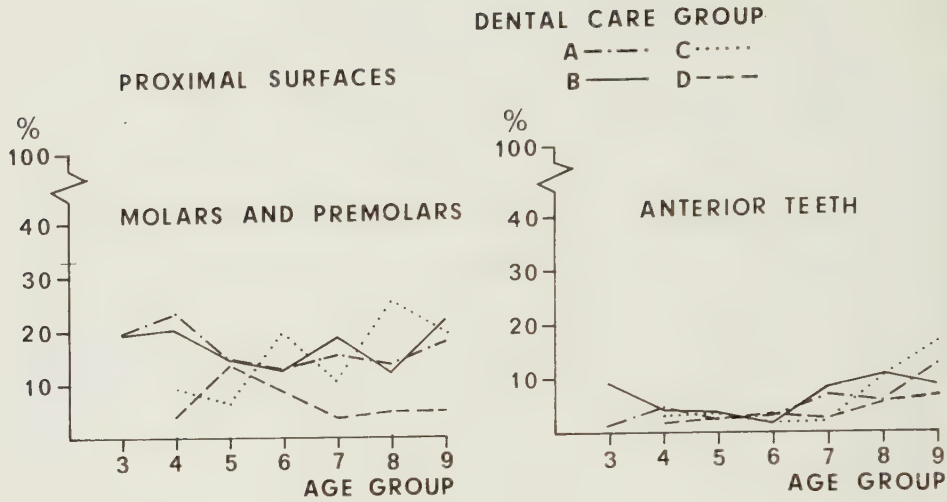


Fig. 42. Percentage distribution on age and dental care of individuals having had "new" restorations during the interval.



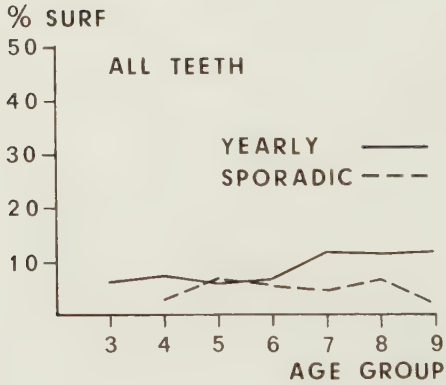


Fig. 43. Percentages of surfaces with "new" restorations related to age and dental care.

New crowns

Crowns were provided for a greater percentage of individuals in the yearly dental care group than in the sporadic one during the interval 1965-1971 ($p < 0.001$), Fig. 44. Calculated on those individuals, the means of the mean number of new crowns per individual were about the same in the yearly and sporadic groups (Table 18). If, however, all dentate participants are considered, the frequency of new crowns was higher in the yearly group, Fig. 45).

Table 18. Means of mean number of new crowns per individual. (Calculated on individuals having had crowns made during the interval 1965-1971).

Dental care group	Yearly			Sporadic		
Age group	N	mean	s.d.	N	mean	s.d.
3	9	1.6	.73			
4	19	1.8	1.44	4	2.0	.82
5	24	1.8	1.20	4	2.3	.96
6	37	2.7	2.26	6	1.8	.75
7	56	3.4	2.52	6	2.5	3.21
8	33	2.6	2.44	10	2.1	2.18
9	8	2.8	1.49	3	2.3	1.53

In the yearly dental care group the average number of new crowns per individual was at a maximum in the age range 45 to 55 years (age group 7), while in the sporadic dental care group the corresponding number was about the same throughout the age groups. Fig. 45 also shows the average numbers of crowns remade and present, as well as the number of crowned teeth extracted during the interval 1965 to 1971.

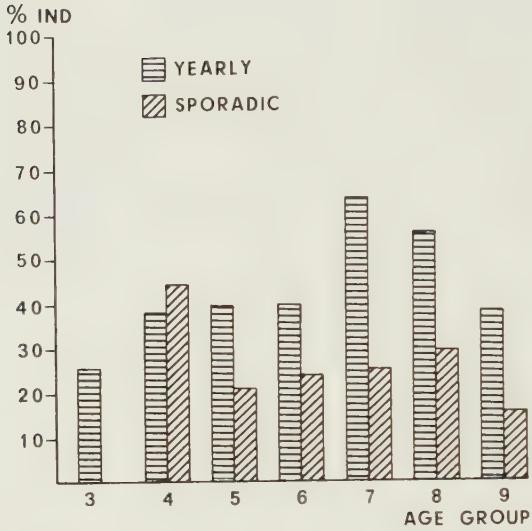


Fig. 44. Percentage distribution on age and dental care of individuals having had crowns made during the interval.

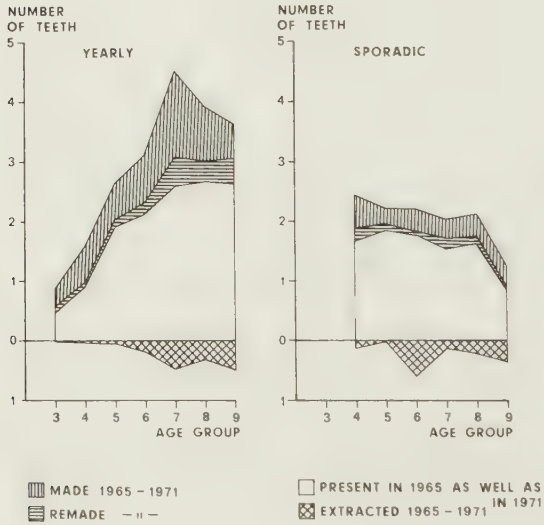


Fig. 45. Average number of crowns per individual in yearly and sporadic dental care group.

Endodontic therapy

Higher percentages of participants belonging to the yearly dental care group had had endodontic treatment during the interval between examinations than those belonging to the sporadic group ($p < 0.005$). The differences increased with increasing age, (Fig. 46).

In Table 19 only those persons who had endodontic treatment during the interval are considered. The mean numbers of treated teeth per individual did not vary to a great extent with age and there were no considerable or significant differences between the yearly and the sporadic dental care groups.

Table 19. Means of mean number of teeth per individual endodontically treated 1965-1971. (Calculated on individuals having had endodontic treatment during the interval).

Dental care group	Yearly			Sporadic		
Age group	N	mean	s.d.	N	mean	s.d.
3	13	1.4	.65			
4	16	1.5	.89	2	2.0	.00
5	25	1.4	.82	7	1.6	1.13
6	41	1.8	1.19	8	1.1	.35
7	46	1.7	.97	7	1.1	.38
8	27	1.6	.88	8	1.4	1.06
9	8	2.3	1.28	1	1.0	.00

The frequency of teeth that had been subjected to endodontic treatment in 1965 calculated on all dentate participants was compared to the corresponding frequency in 1971, (Fig. 47). The percentages showed a steady rise with rising age in the yearly, but not in the sporadic dental care group.

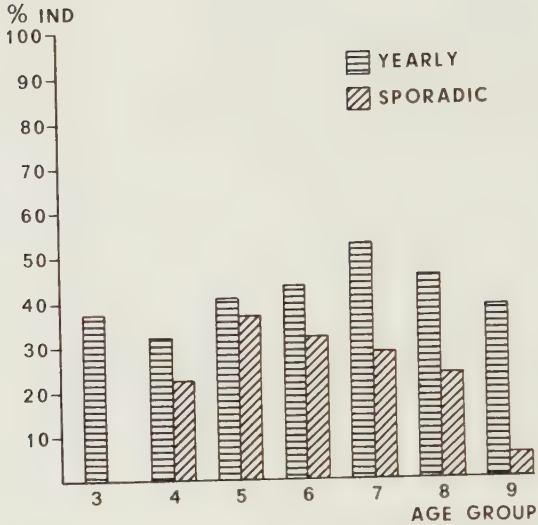


Fig. 46. Percentages of individuals having had endodontic treatment during the interval.

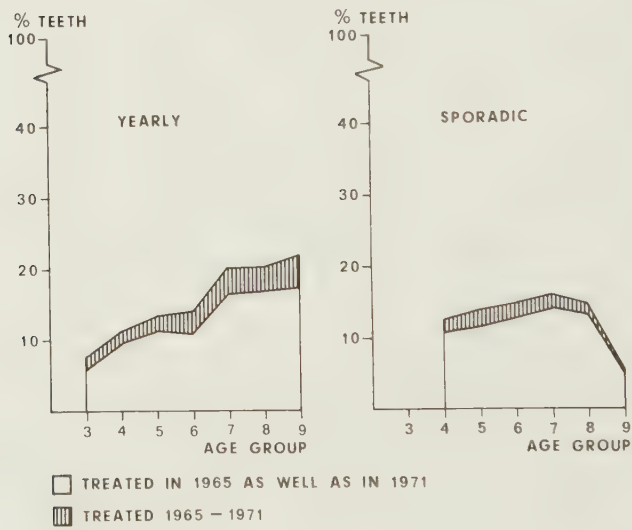


Fig. 47. Average percentages of endodontically treated teeth per individual in yearly and sporadic dental care group.

Periodontal bone height 1965-1971

For each individual possessing mandibular molars and/or premolars the mean bone score was computed from the orthopantograms obtained in 1965 and 1971. The means of the individuals means were then calculated for the separate dental care categories within each age group. It must be emphasized that the figures given below apply to teeth remaining at each of the two examinations.

The 1971 orthopantomograms gave higher means than the 1965 ones. This statement holds true for mandibular molar and premolar areas separately, and combined, as well as for the total sample or for the different age groups and dental care groups (Table 20 and Fig. 48).

This is in accordance with the common experience from epidemiological research that a progressive marginal bone destruction develops with increasing age. The differences between the 1965 and 1971 mean bone scores were negative throughout, but fairly slight - ranking in the different age and dental care groups between 0.5 and 7.3 per cent of the total tooth length. In spite of the small size, those differences with few exceptions were statistically significant.

It is of special interest that there were no appreciable differences between dental care groups in respect of the amount of bone destruction during the interval between the two examinations (Fig. 49).

In order to find out whether the observed progression of bone destruction was caused largely by progress around teeth which were affected already in 1965, the proportions of bone scores ≤ 4 proximal of teeth present both in 1971 and 1965 were compared by chi-square tests, Table 21. These proportions had decreased significantly in all dental care groups when all age groups were comprised. That is to say that progression occurred also around teeth which in 1965 did not display periodontal bone reduction.

Table 20. Proximal bone heights in mandibular molar and premolar areas scored on orthopantomograms made in 1965 (I) and 1971 (II) respectively. Calculations based on individual means of bone scores for each examined person.

	Areas	Examin.	Number of individuals	Mean	s.d.	t	p
Molar + Premolar	Mes	I	614	4.55	.711	-2.962	<.005
		II	611	4.67	.764		
	Dist	I	627	4.71	.667	-3.009	<.005
		II	621	4.82	.708		
	Mes + Dist	I	627	4.63	.667	-3.061	<.005
		II	621	4.75	.701		
Molar	Mes	I	554	4.65	.790	-1.561	>.100
		II	541	4.72	.802		
	Dist	I	560	4.89	.714	-3.321	<.001
		II	543	5.04	.795		
	Mes + Dist	I	562	4.77	.698	-2.621	<.01
		II	545	4.88	.750		
Premolar	Mes	I	536	4.40	.671	-3.700	<.001
		II	553	4.56	.733		
	Dist	I	598	4.50	.681	-3.004	<.005
		II	599	4.62	.697		
	Mes + Dist	I	602	4.46	.650	-3.421	<.001
		II	602	4.59	.683		

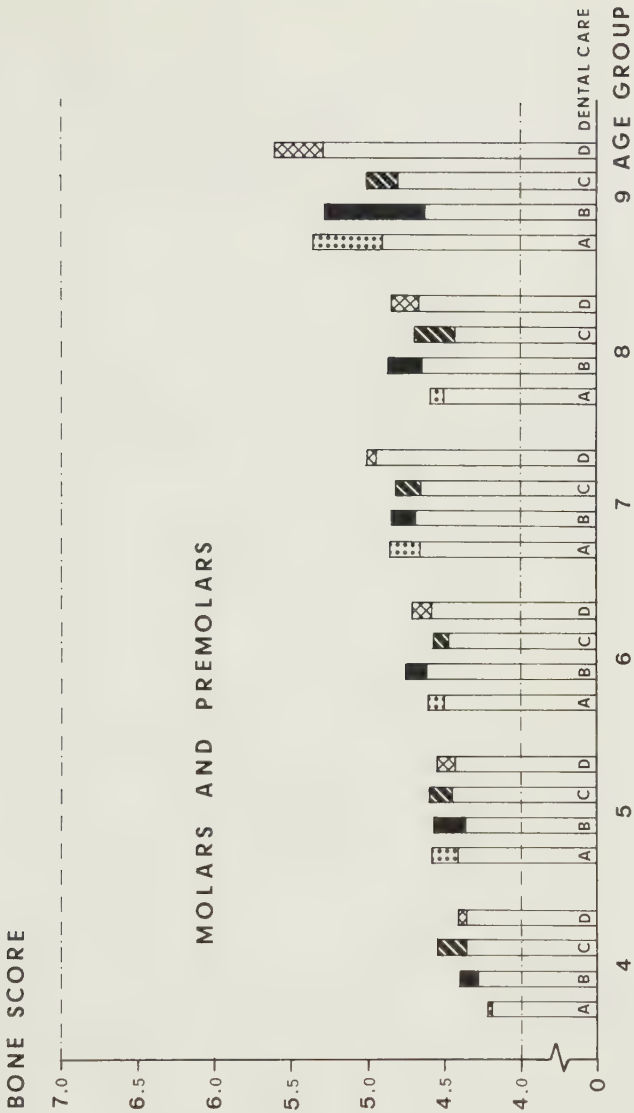


Fig. 48. Bone score 1965 and 1971 in relation to age and dental care.
The differentially shaded blocks represent differences between the measurements in 1965 and in 1971. The lines at bone score 4.0 and 7.0 represent total and half of the root length respectively.

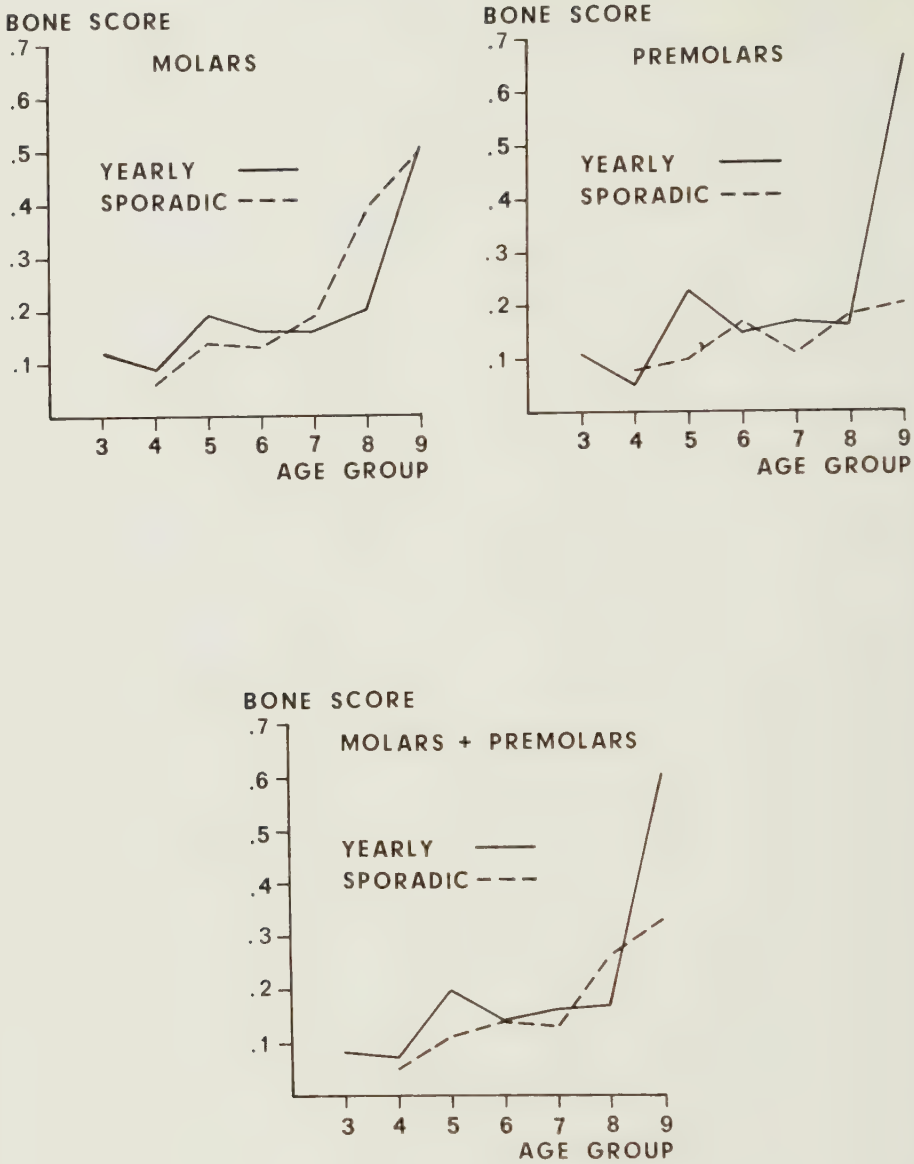


Fig. 49. Differences in bone score measurements in 1965 and in 1971 in yearly and sporadic dental care group.

Table 21 Percentages of mandibular molars and premolars with bone score ≤ 4.

Age gr.		Dental care group A 1965	Dental care group A 1971	Dental care group A Level of significance	Dental care group B 1965	Dental care group B 1971	Dental care group B Level of significance
Age gr.	3	83.64	78.52	N.S.	73.55	66.19	N.S.
	4	80.55	77.90	N.S.	67.28	62.78	N.S.
	5	62.37	49.46	$p < 0.001$	64.33	50.95	$p < 0.01$
	6	57.35	48.52	$p < 0.01$	54.45	40.33	$p < 0.01$
	7	43.80	37.47	N.S.	53.04	36.90	$p < 0.001$
	8	56.20	50.00	N.S.	52.30	29.75	$p < 0.01$
	9	56.25	13.33	$p < 0.001$	37.14	23.07	N.S.
	3-9	61.23	53.79	$p < 0.001$	59.38	45.70	$p < 0.001$

		Dental care group C 1965	Dental care group C 1971	Dental care group C Level of significance	Dental care group D 1965	Dental care group D 1971	Dental care group D Level of significance
Age gr.	4	67.28	59.83	N.S.	66.33	62.50	N.S.
	5	64.33	57.40	N.S.	60.67	53.09	N.S.
	6	54.45	49.56	N.S.	49.70	40.57	N.S.
	7	47.80	41.20	N.S.	26.70	23.07	N.S.
	8	52.30	46.66	N.S.	46.36	43.75	N.S.
	9	37.14	21.87	N.S.	21.25	19.23	N.S.
	4-9	55.21	49.10	$p < 0.01$	45.98	40.72	$p < 0.02$

In this investigation endevours were made at describing the dental health condition in groups formed on the basis of age and dental care frequency. Such attempts involve difficulties of a kind that every researcher within this field of epidemiology will experience. One of the most tangible reasons is the considerable variation of dental parameters of the kind discussed below between individuals selected on the basis of non-dental criteria such as education, income, dental care habits etc.

Particulars on the dental state are usually given with reference to the number of remaining teeth or tooth surfaces per individual. In dentate persons the reference figure may vary from one to 32 teeth or from 3 to > 100 surfaces. The variation in the number of teeth within each separate group is great and increases with increasing age.

The proportions of intact, carious or restored teeth or tooth surfaces calculated on the number of remaining teeth are primarily influenced by the rather substantial variation in the latter number. Therefore, the variation of e.g. the proportion of carious surfaces within a specific group will depend partly on this "primary" variation and partly on the variation that emanates from the varying individual caries experience. These circumstances make the interpretation of means of individual means rather difficult and may also obscure differences which in reality prevail.

The evaluation of differences between different groups of individuals that may occur, is further rendered difficult by another fact. The reduction of the dentition with increasing age usually involves changes in the relative numbers of molars, premolars and anterior teeth. Such changes are most conspicuous regarding the relative numbers of molars and anterior teeth. E.g. in the sporadic dental care group, age 4, molars make up on an average 27 per cent and anterior teeth 46 per cent of the dentition. In age group

9 the corresponding figures are 15 per cent molars and 58 per cent anterior teeth. These two types of teeth differ greatly from cariologic as well as periodontologic points of view, which still more complicates the evaluation of frequency figures. Consequently, yonger groups with more or less complete dentitions cannot without reservations be compared with older ones.

In this report diagrams appear in which points representing proportions, means or scores in different age groups are joined by lines, which may suggest a direct connection between age groups. This way of presenting results has been chosen solely in order to make the diagrams more easily readable and does not imply any indication of an age dependent development. Results within any age group are to be considered as snapshots of the state within this specific age group at the occasion of examination. In analogy with this, objections may also be raised against comparisons within one age group between different sub-groups, if they differ considerably in distribution of different types of teeth.

In order to make comparisions of this kind reliable the individuals ought to be divided in subgroups according to the number of remaining teeth. Within the same age group e.g. different dental care groups with the same number of remaining teeth could be compared. However, this would require far more participants than those available in the present investigation.

DENTAL HEALTH STATE IN DENTATE INDIVIDUALS IN RELATION TO EDUCATIONAL LEVEL AND DENTAL CARE

The dental care frequency is not determined by any single factor. Caries activity and periodontal disease, but also sex, education and economy (Chulis /1966/, Smedby /1972/) may influence the dental care frequency. It may well be, that the relative importance of such factors varies with age.

The educational level may be one of the primary factors that govern patterns of dental care and oral hygiene, attitudes to dental problems, nutrition and other habits that may have an influence on dental health.

Fig. 50 shows the differences in the average percentages of missing, filled and carious teeth in relation to remaining ones in the different educational groups within the yearly dental care group. There were only insignificant differences as far as restored and carious teeth were concerned. This may be due to the relatively small differences in the educational level within the present material. The differences in frequency of restored teeth between manual workers and staff, which were reported by Björn (1971) may well reflect differences in dental care habits between these educationally far more separated groups.

The educational groups differed to a somewhat greater extent in the frequencies of missing teeth. This may be explained by a greater disposition among the lower educational groups towards extractions as the therapy of choise.

An analysis based on dental care within the separate educational groups may give an idea of the relative influence of these two factors on the dental health. It was not possible to do this within the educational group "high", because of the small number of individuals within each age group in the sporadic dental care group.

Fig. 51 gives an account of the average percentages of missing, filled and carious teeth within the yearly and sporadic dental care groups for the two lower educational groups.

Greater homogeneity prevailed within groups with the same dental care habits than within groups of the same educational level. This is a similar tendency to that observed when the total material was divided according to dental care and suggests that comparisons of the dental health conditions between groups with a

Fig. 50. Percentages of missing, filled and decayed teeth in the yearly dental care group in relation to age and educational level.

different socio-economic background will be really relevant, after they have first been divided also according to dental care frequency.

Without putting too much stress on the figures presented in this discussion, they may suggest the advisability of devoting serious efforts towards the selection of suitable criteria for the division of a population into sub-groups.

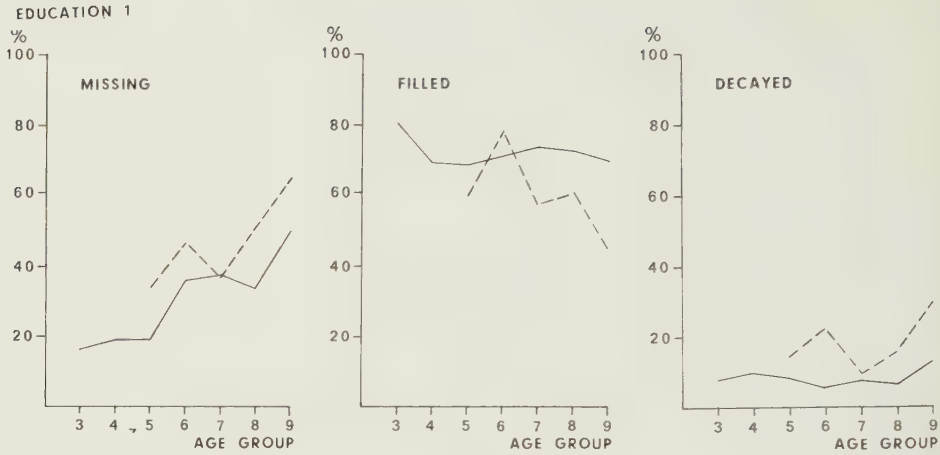


Fig. 51. Percentages of missing, filled and decayed teeth in educational group "low" (1) and "medium" (2) in relation to age and dental care.

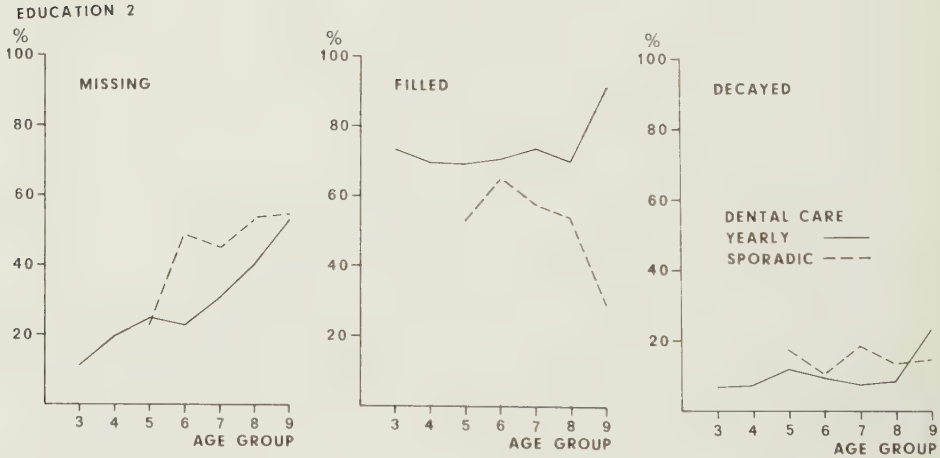


Fig. 51. Percentages of missing, filled and decayed teeth in educational group "low" (1) and "medium" (2) in relation to age and dental care.

The dental health state of an individual reflects the influence during his whole life of a multitude of often interrelated factors such as hereditary disposition to dental disease, systemic disease, environmental conditions and their changes, education, economy, preventive dentistry and dental treatment (frequency, type, quality etc) and others.

To describe the dental health state with the aid of an irreversible index such as DMF is not satisfactory. Several authors e.g. Ainamo and Alvesalo (1970) have pointed out that in adults only an indistinct conception of the dental health state can be presented by DMF-figures. This is clearly evident from the fact that DMF-figures (or proportions of intact teeth, which are complementary figures) do not vary considerably with dental care group and age. Thus, there is need for separate surveys of each of the parameters of which the DMF-index is composed. These are capable of presenting an accurate picture of the dental health state.

The number of lost teeth and the actual periodontal bone height are mainly reminiscences of events in a more or less distant past. In contrast to those parameters, untreated carious lesions as well as periodontal inflammation may be considered mainly as reflections of the present oral health state and habits (including the professional attitudes of the present dentist).

The proportion of remaining teeth with restorations was greater in the yearly dental care group than in the sporadic dental care group. This might be interpreted as being due to a better dental health state in the sporadic dental care group. However, as shown by Fig. 52, the average number of restored proximal surfaces per individual in posterior teeth, was proportional to the number of remaining teeth (Fig. 12). This suggests that among molars and premolars, mainly teeth with proximal restorations have been extracted.

The yearly and sporadic dental care groups displayed a striking

uniformity in the mean numbers of unrestored proximal surfaces (Fig. 52). This interesting fact, together with a close agreement between the two dental care groups in the proportions of proximal surfaces with primary caries, must lead to the conclusion that there was no appreciable difference in "non-destructed" surfaces. In other words the incidence of dental disease has been about the same in the yearly and the sporadic dental care groups.

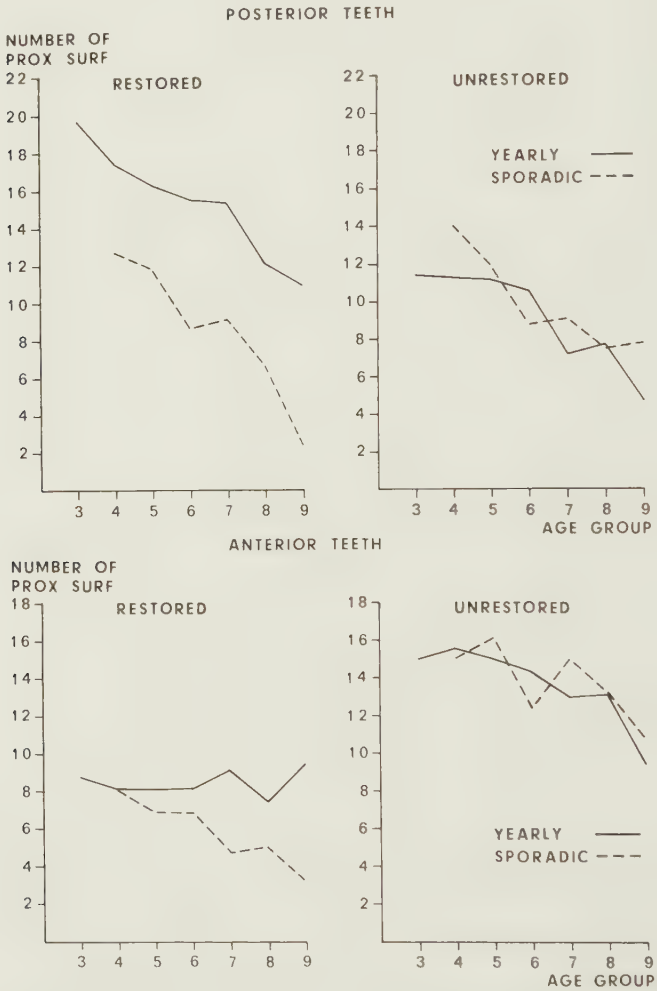


Fig. 52. Number of restored and unrestored proximal surfaces per individual in yearly and sporadic dental care groups.

DETERIORATION OF DENTAL HEALTH DURING THE OBSERVATION TIME

TOOTH LOSS

Many different factors have an influence on the indications for extraction of teeth (Grewe et al. 1966, Trott and Cross 1966, Gray et al. 1970, Johansen 1970 and others). The attitude of the patients towards dental treatment is likely to be one of the main ones. Further, the varying preferences of different dentists influence the choice between extraction and other therapy.

Extractions are more common in individuals who only sporadically are subjected to dental treatment. Teeth with extensive carious lesions or more or less advanced periodontal involvement are extracted rather than conserved. In persons belonging to the regular dental care groups such teeth are more often treated with fillings and crowns, utilized as bridge abutments etc. As a consequence the yearly dental care group has more teeth left, while the remaining teeth in the sporadic dental care group often show better conditions, e.g. a lower proportion of filled, crowned and endodontically treated teeth and a higher proportion of intact ones. These circumstances constitute obstacles to comparisons of dental health between groups of individuals with different dental care habits and which overmore have been treated by a great number of different dentists.

It may be profitable to study the changes in dental health conditions in groups that have had regular dental care during the six-year interval between examinations. Such a study may give some insight into the capability of present-day dentistry to create and preserve dental health.

In spite of what has been said above, frequent extractions have been made also in the yearly dental care groups. A definite explanation for this fact cannot be arrived at on the basis of the pre-

sent material. One can only meditate on the reasons. Caries has probably been a minor factor in persons who had been subjected to yearly treatment. This view is supported by the fact that the incidence of untreated carious lesions and especially that of deep enamel-dentine caries was so slight at the examination in 1971.

Periodontal involvement may be a factor of major significance, at least in the higher age groups (Krogh 1958, Andrews and Krogh 1960, Johansen 1970). However, a definite age after which periodontal indications dominate - as has been suggested by several authors - is difficult to state.

Indications for extractions are often mixed. E.g. periodontal disease frequently causes denudation of the root cement which may lead to cement caries. Obviously, this caries is secondary to periodontal disease. To my knowledge such distinctions have not been used in the investigations cited above.

Swedich dentists have recorded "prosthetic" indications as the cause of 40-50 per cent of extractions in the age groups over 30 years (Lundqvist 1967). However, this must be considered as an odontologically inadequate concept (cf. Johansen 1970). It is probable that many teeth have been extracted in order to facilitate the manufacturing and wearing of prosthetic appliances, teeth which under other circumstances (e.g. economic ones) might have been retained and treated, that is to say that extractions frequently are made without strict odontological indications. However, numerous extractions of a "prosthetic" nature have probably in reality been made on periodontal indications.

That periodontal disease has played an important part as an indication for extractions may be inferred from the average bone scores which at the examination in 1965 were higher for subsequently extracted teeth than for remaining ones.

CONSERVATIVE DENTISTRY

An evaluation can to some degree be made of the different therapeutic measures, such as fillings, crowns and endodontic treatment, which have been carried out during the interval between the two examinations. E.g. restorative therapy on teeth or tooth surfaces that were "intact" in 1965 - as could be expected - was most frequent within the yearly dental care groups.

Many authors (Westin 1942, Brosch 1943, Sellman 1944) have suggested that an ample fraction of the working hours of dentists is devoted to revision of already existing restorations. An attempt to assess the proportion of earlier treated surfaces, that have been restored anew during the interval 1965-1971, was made in the present treatise. Table 22 shows the numbers per indivual and the percentages of earlier restored surfaces that were treated again during the interval. This is in accordance with the observed frequencies of untreated caries (cf. Fig. 18). Even if a statistic like this can hardly be said to be exact it is nevertheless clear that the therapy involved restored surfaces as often as untreated ones. This statement holds true for both the yearly and sporadic dental care groups.

Table 22. Number and percentages of earlier restored surfaces per individual treated again 1965-1971.

Age group	3	4	5	6	7	8	9
Yearly dental care							
Number of surfaces/ind	6.8	6.6	6.2	7.1	7.4	4.3	3.6
% of earlier restored surfaces	15.7	17.7	15.8	18.6	18.8	13.7	11.7
Sporadic dental care							
Number of surfaces/ind		4.9	4.0	2.7	2.8	2.0	0.8
% of earlier restored surfaces		13.8	14.2	10.3	11.8	10.5	8.6

PERIODONTAL BONE HEIGHT

Several investigations have shown that it is possible to prevent progression of periodontal disease and thereby of progressive resorption of periodontal bone. Schei et al. (1959) have demonstrated that the alveolar bone height has a definite relation to oral hygiene, while Suomi et al. (1971a, 1971b) have been able during a 3-year period to bring resorption down to a very low amount by "controlled oral hygiene procedures".

It might be expected that those groups that have had the benefit of regular dental care would have exhibited less alveolar resorption than the sporadic dental care group. No tendency in this direction was, however, observed for mandibular molars and premolars. Whether this is due to more extractions of teeth with a rapidly progressing resorption in the sporadic group, is an open question. It is, however, clear that no significant difference in reduction of bone height between the dental care groups could be verified for teeth that were present in 1965 as well as in 1971.

FREQUENCY OF "ESTABLISHED" PERIODONTAL DISEASE

According to Russel (1956) "established" periodontal disease prevails when the mean P I surpasses 1.5. If this concept is applied to the present material almost all age and dental care groups displayed "established" periodontal disease.

The occurrence of periodontal disease may be discussed also against the background of other criteria e.g. the presence of pathological pockets, of serumal calculus and of periodontal bone height. Measurments of the periodontal bone height give a view of the accumulated effect of periodontal disease.

All age and dental care groups displayed mean bone scores above 4. This figure must be taken as a sign of the occurrence of at least some degree of bone loss in each dental care group, within each of the age groups studied (ages 30 to 65) and consequently

confirm the results of the P I assessments (cf. Bellini /1973/).

A more diversified outlook may be obtained from the diagrams showing the frequency of individuals or teeth with serumal calculus and/or pathological pockets (Fig. 53). The occurrence of subgingivally mineralized calculus in amounts that can be observed on the roentgen films or of pathological pockets established by use of a measuring probe would seem to indicate that a marginal periodontitis has been active. Evaluation of these signs indicated that "established" periodontal disease had occurred in most of the individuals examined in the present investigation. Differences in distribution between the yearly and sporadic dental care groups were slight.

FACTORS WHICH MAY INFLUENCE THE FREQUENCY OF PERIODONTAL DISEASE

It is remarkable that the frequency of individuals with signs of periodontal disease is so high in the groups that regularly visit their dentists for at least one treatment period a year. The possible reason for this will be discussed.

The difficulty in diagnosing the disease is probably one factor of importance. Roentgen examination is one of the simplest and most effective diagnostic means, yet previous investigations (Gray et al.1970, Gröndahl and Blomberg 1971, Gröndahl et al.1974) have disclosed a remarkably low number of roentgen films exposed per treated patient.

A corresponding investigation has not been made on the present material. However, some idea on this problem may be obtained from the results of the interview examination. The participants were asked to state (against the background of the bite-wing examination they underwent a few minutes earlier) if they had any similar examination made during the interval between the 1965 and 1971 examinations. A discussion followed, aimed at disclosing whether a full mouth roentgen examination, bite-wing exposures or roent-

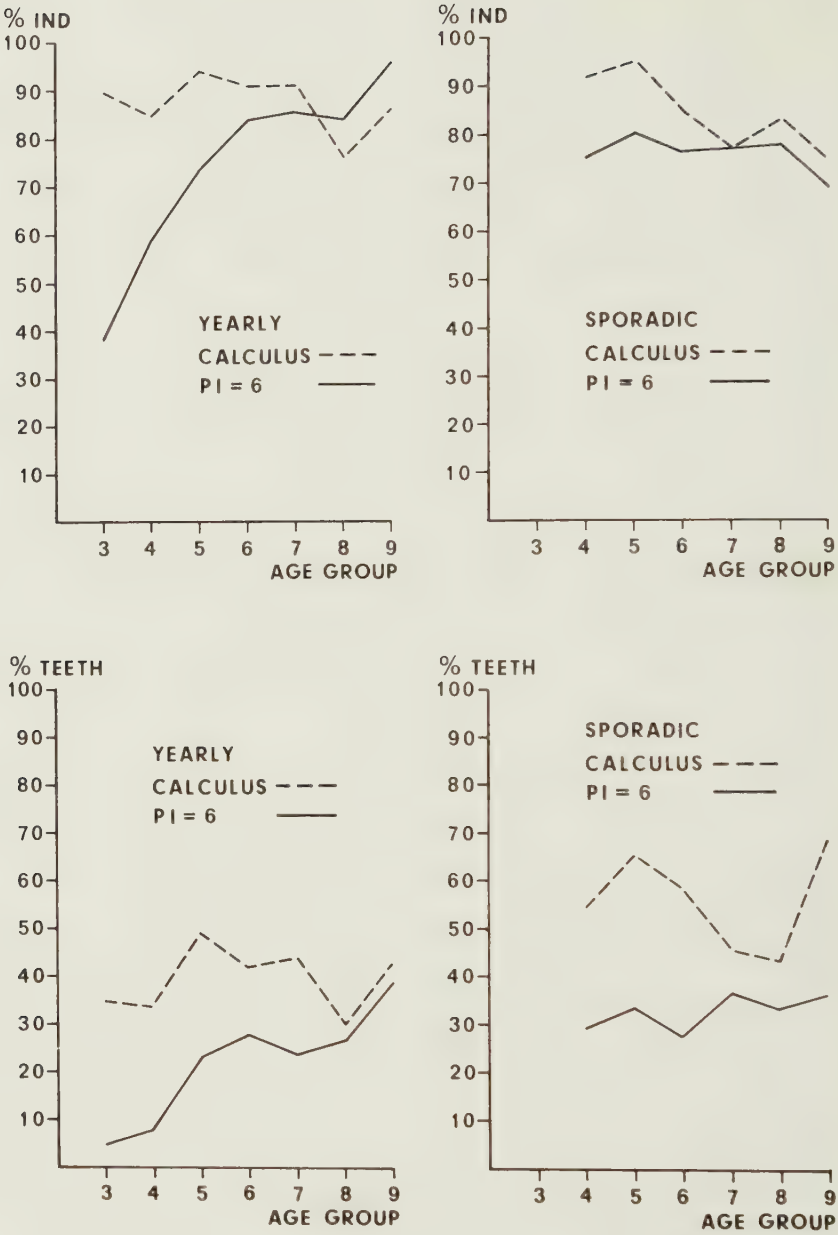


Fig. 53. Percentages of individuals and of remaining teeth with proximal calculus and pathological pockets in yearly and sporadic dental care groups.

gen examination of single teeth had been performed. The veracity of the answers has not been assessed but in spite of this, the results may serve as a background for a discussion of the periodontal findings within the groups with regular dental treatment, Fig. 54.

Ten to 25 per cent of the individuals stated that they had had no roentgen examination, 20 to 45 that only single teeth had been examined, 15 to 60 that bite-wing examinations had been made and 5 to 15 that full mouth roentgen examination had been performed. The figures indicate that bite-wing examinations were much more common within the lower age groups.

That many cases of periodontal disease escape diagnosis may also be due to the absence or mild degree of the symptoms. Fig. 55 shows the percentages of individuals within the yearly and sporadic dental care groups who stated that they had bleeding from the gingivae at tooth-brushing. The frequency is relatively high but without significant differences between the dental care groups. Bleeding from the gingivae is often not regarded as a pathological sign and consequently is not always considered as an indication for treatment.

Within the yearly dental care group, between 70 and 90 per cent of the individuals stated that they had had dental calculus removed at their last visit (Fig. 56). It is impossible to draw any definite conclusions from this on the effectiveness of removal of calcified deposits. It is a fact that this group had less supragingival calculus on their mandibular incisors than the sporadic one. However, there was no appreciable difference in the occurrence of proximal calculus of the serumal type between the dental care groups.

One of the important factors for motivating patients to employ preventive measures and seek treatment is knowledge about periodontal disease. About 50 per cent of the participants stated that they were ignorant of the causes of periodontal disease (Fig. 57).

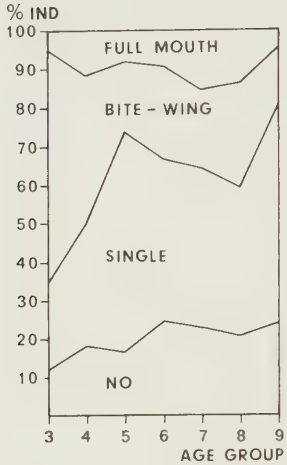


Fig.54. Distribution of occurence and type of X-ray examination during 1965 -1971 in groups with yearly dental care.

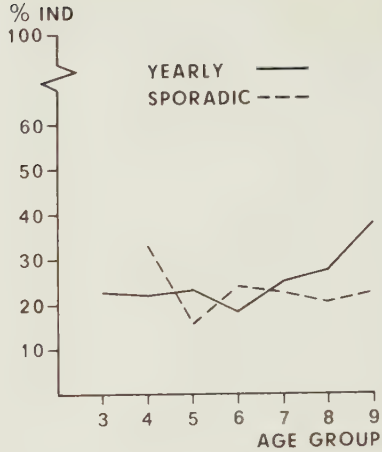


Fig.55. Percentages of individuals with bleeding from the gingiva by tooth brushing.

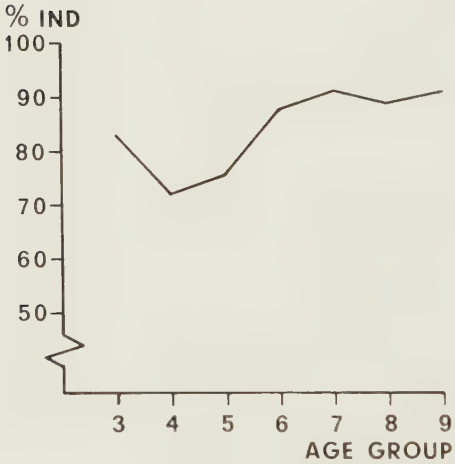


Fig.56. Percentages of individuals, in groups with yearly dental care, stating that depuration was included in the treatment ≤ one year ago.

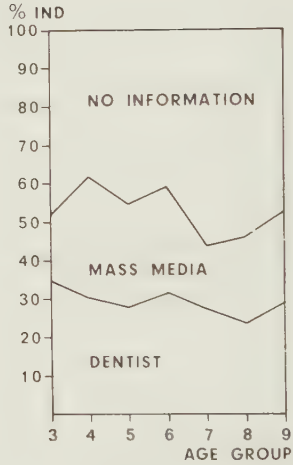


Fig.57. Distribution of occurence and origin of paradontological information in groups with yearly dental care.

About the same proportions of the remaining ones had had information from mass media and dentists.

PROGRESSION OF DENTAL DISEASE

The aim of this investigation was among other things to "find out whether the progression of dental disease during a six year period is influenced by age and/or dental care".

The concept "dental health" can not be defined in a simple way and consequently the dental health state cannot be numerically summarized by one single parameter. "Dental health" includes a series of factors which combined give an idea of the dental health conditions.

However, one may venture to select one or two of these factors in order to throw some light on the question to what degreee age and/or dental care has had an influence on the dental state during the six year period comprised in the present study. The number of intact (not restored) surfaces lost during a defined period does to some extent show the degree of progression of dental disease, while the extent to which alveolar bone has been lost gives an idea of the progression of periodontal disease.

Fig. 58 gives, from this maybe narrow angle of approach, an account of changes in "dental health" in relation to age and dental care. The percental loss of previously unfilled proximal surfaces was calculated on remaining proximal surfaces in 1965. In this connection extraction as well as restoration was considered as "loss". Differences in bone scores assessed proximal to posterior mandibular teeth from orthopantomograms made in 1965 and 1971 illustrate the progression of periodontal disease. The variations with age as well as with dental care were found to be rather small in this sample in spite of the differences between the groups that have been reported above.

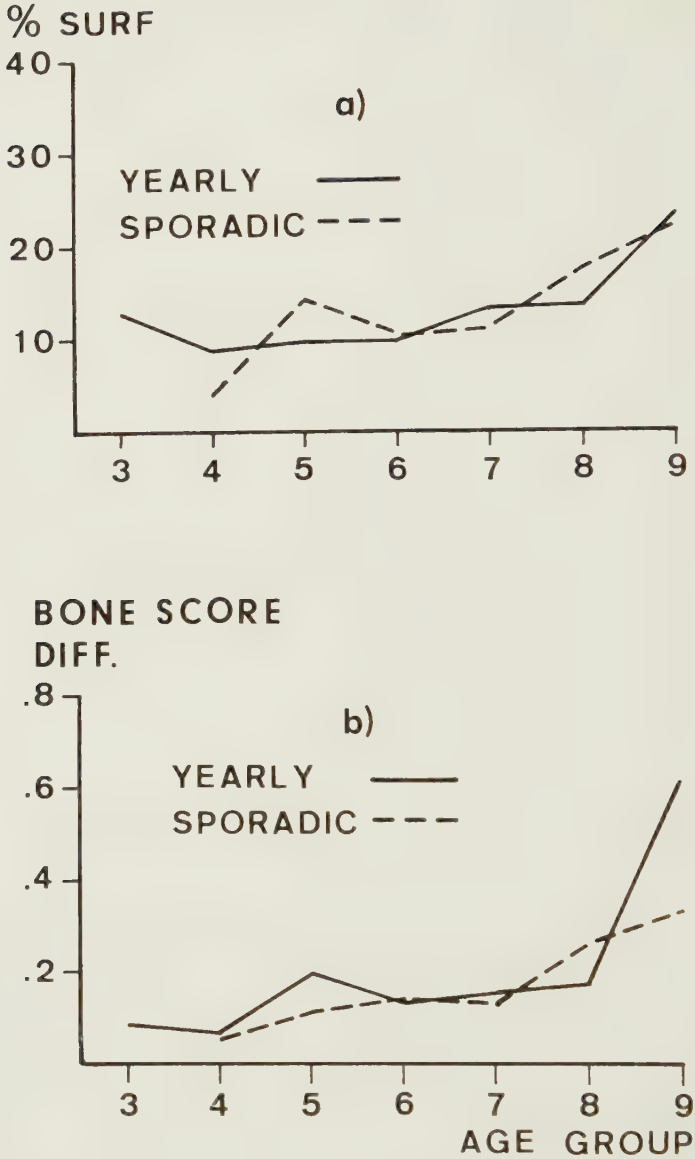


Fig. 58. a) Percental "loss" of proximal unrestored surfaces and b) reduction of proximal bone height between 1965 and 1971.

In summing up, one is obliged to admit that dental disease - estimated in these ways - seems to progress at about the same rate at all ages and that in this sample preventive measures against dental disease have not been employed to such an extent as to preclude a measurable progression.

SUMMARY

MATERIAL

In 1965 H Björn conducted a dental health investigation of employees of the Kockums Mekaniska Verkstads AB, Malmö, Sweden. The present treatise reports the results of a re-examination in 1971 of male staff members who participated in the 1965 examination and were still employed by the same firm. 93 per cent of these or 653 persons participated once more.

At both examinations roentgenographic and photographic recordings were obtained. This made a longitudinal study of changes in the dental conditions feasible.

In 1971 the participants were interviewed on their dental care frequency, which made it possible to relate the dental state to the dental care frequency. Almost 65 per cent of the participants had visited their dentist at least once a year during the interval between the two dental health examinations. The proportion of individuals belonging to the yearly group was found to be at a maximum in the lowest age group and to decrease with increasing age.

DENTAL HEALTH STATE IN 1971

The survey of edentulous persons was incomplete due to the refusal of some subjects to participate in the investigation. However, a great majority of the edentulous participants belonged to the sporadic dental care group. The main aim of this part of the study was to demonstrate the dental health state in dentate individuals in relation to dental care frequency.

The groups with sporadic dental treatment had lost more teeth than the regular dental care groups. In the latter ones on an average 70 per cent of remaining teeth had been subjected to restorative therapy, while the sporadic dental care group displayed a

considerably lower proportion of restored teeth. The yearly dental care groups had somewhat more extensive restorations than the sporadic one. About 40 to 50 per cent of restorations in posterior teeth had a measurable overhang. There were no significant differences between the dental care groups.

The sporadic dental care group had on an average more secondary caries and caries involving root cement than the yearly group, while there was no difference in the occurrence of primary caries.

About 80 to 90 per cent of the individuals in the yearly dental care group had had endodontic treatment. In the sporadic group the corresponding percentages were considerably lower. The mean number of endodontically treated teeth per endodontically treated individual was about the same.

PERIODONTAL CONDITIONS IN 1971

This study confirmed previous observations that the P I is correlated to the dental care frequency. In the yearly dental care group the proportion of teeth as well as the proportion of individuals with P I scores ≥ 6 increased with increasing age while an increase was not clearly evident within the sporadic group. However, the proportion of teeth with this score level was greater in the sporadic group. The proportion of individuals with > 50 per cent of remaining teeth assigned P I scores ≥ 6 was also greater in the sporadic group.

Bone score assessments proximal to mandibular molars and premolars unveiled a significantly greater reduction of the alveolar bone height in the sporadic dental care group.

The proportions of individuals with proximal calculus were about the same in the yearly and sporadic dental care groups. The proportions of teeth with this type of calculus were, however, somewhat higher in the sporadic dental care group. There was no considerable variation with age. The proportion of individuals

with mineralized plaque covering > 1/4 of the lingual surfaces of mandibular incisors was significantly higher within the sporadic than within the yearly dental care group.

CHANGES IN DENTAL HEALTH CONDITIONS DURING THE INTERVAL BETWEEN THE EXAMINATIONS IN 1965 AND 1971

TOOTH LOSS

The average numbers of lost teeth per individual increased with increasing age and were higher in the group with sporadic dental care, as were the percentages of individuals having lost teeth during the period. The distribution of lost teeth within the different groups of teeth (molars, premolars and anterior teeth) was about the same within the dental care groups.

The majority of the lost teeth were restored. There was no significant difference between the dental care groups in the frequency of lost restored or lost intact teeth. Throughout the age groups bone scores were higher for lost than for remaining teeth in both the yearly and the sporadic dental care groups. The differences increased with age in both yearly and sporadic dental care groups.

RESTORATIONS MADE DURING THE INTERVAL 1965 TO 1971

About 10 per cent of surfaces which in 1965 were free from restorations displayed restorative work in 1971. There were only small variations between age groups. Between 3.5 and 5 surfaces had been restored per individual. The highest number occurred in the lower age groups. 40 to 50 per cent of the individuals in the yearly dental care group displayed "new" restorations - significantly more than those in the sporadic group. The majority of "new" proximal restorations had been made in posterior teeth.

A greater percentage of individuals in the yearly than in the sporadic dental care group had been treated with crowns during the interval 1965-1971. However, the mean numbers of new crowns per individual did not differ greatly.

Significantly higher percentages of individuals belonging to the yearly dental care group had had endodontic treatment during the interval between examinations than those belonging to the sporadic one.

PERIODONTAL BONE HEIGHT

A significant reduction of the average periodontal bone height, of the same size in the yearly and sporadic dental care groups, had occurred during the interval 1965-1971.

GENERAL CONSIDERATIONS

An attempt to describe the dental health in groups formed on the basis of age and dental care frequency involves great difficulties due to the considerable variations of dental parameters between individuals which are selected on the basis of non-dental criteria.

The proportions of intact, carious or restored teeth surfaces are primarily influenced by a rather substantial variation in the number of remaining teeth. Variation of e.g. the proportion of carious surfaces will to a considerable extent depend on this "primary" variation and only partly on the varying individual caries experience.

The evaluation of differences between groups is further rendered difficult by an age dependent composition of the remaining dentition: e.g. molars are lost earlier than anterior teeth, two types of teeth which differ greatly from cariologic and periodontologic points of view. Consequently, groups with different distributions of remaining teeth cannot be compared without reserv.

Greater homogeneity in dental health prevailed within groups with the same dental care habits than within groups of the same educational level. This suggests that comparisons of the dental health conditions will be really relevant after they have first been divided also according to dental care frequency.

The number of lost teeth and the actual periodontal bone height are mainly reminiscences of events in the past, while untreated carious lesions and periodontal inflammation may be considered as reflections of the present dental conditions.

The attitudes of the patients towards dental treatment and the preferences of different dentists are likely to be two of the main factors that influence the choice between extractions and other therapy.

Even if extractions were more common in the sporadic dental care groups, teeth were frequently extracted also in the yearly ones. At least in these groups caries has probably been a minor factor, since the incidence of untreated carious lesions and especially that of deep enamel-dentine caries was so slight at the examination in 1971.

That periodontal disease has played an important part as an indication for extractions may be inferred from the average bone scores which were higher for subsequently extracted teeth than for remaining ones.

There was a close agreement between the yearly and the sporadic dental care groups in the proportions of proximal surfaces with primary caries. These two dental care groups also displayed a striking uniformity in the mean numbers of unrestored proximal surfaces. It must be inferred that there was no appreciable difference in "non-destructed" surfaces.

It might be expected that the yearly dental care groups would have exhibited less alveolar resorption than the sporadic one. However, no significant difference in reduction of bone height be-

tween the dental care groups during the six observation years could be verified. That is to say, that the incidence of dental disease was about the same in the yearly and the sporadic dental care groups.

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